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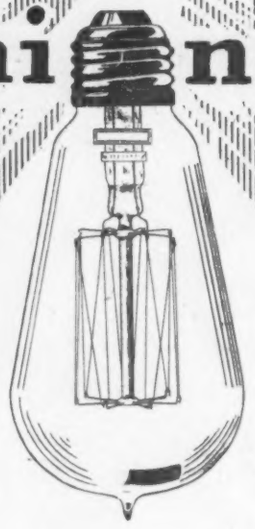

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VOLUME XXVII SAN FRANCISCO, OCTOBER 7, 1911 NUMBER 15

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EVAPORATIVE TESTS ON A WATER TUBE BOILER

BY R. F. CHEVALIER.

Evaporative tests were made by the writer in January and March, 1911, on one of the boilers in the Southern Pacific Company's Fruitvale power station, Fruitvale, California. This station has twelve 645 h.p. water tube boilers arranged in batteries with two boilers to the battery.

The object of these tests was to determine the efficiency of the boiler when operating at its normal rating. The test of January 5th was made to fulfill a guarantee clause in the contract of purchase. The results of these tests indicated a general performance of such a high degree of excellence that it seemed advisable to secure their confirmation through a second test carried out under the supervision of a committee of engineers. To this end the services of Professor W. F. Durand were secured and, on March 18th, another test was made with Professor Durand, W. C. Miller, engineer of power stations for the Southern Pacific Company, and the writer, acting as a committee. The results of this latter test served

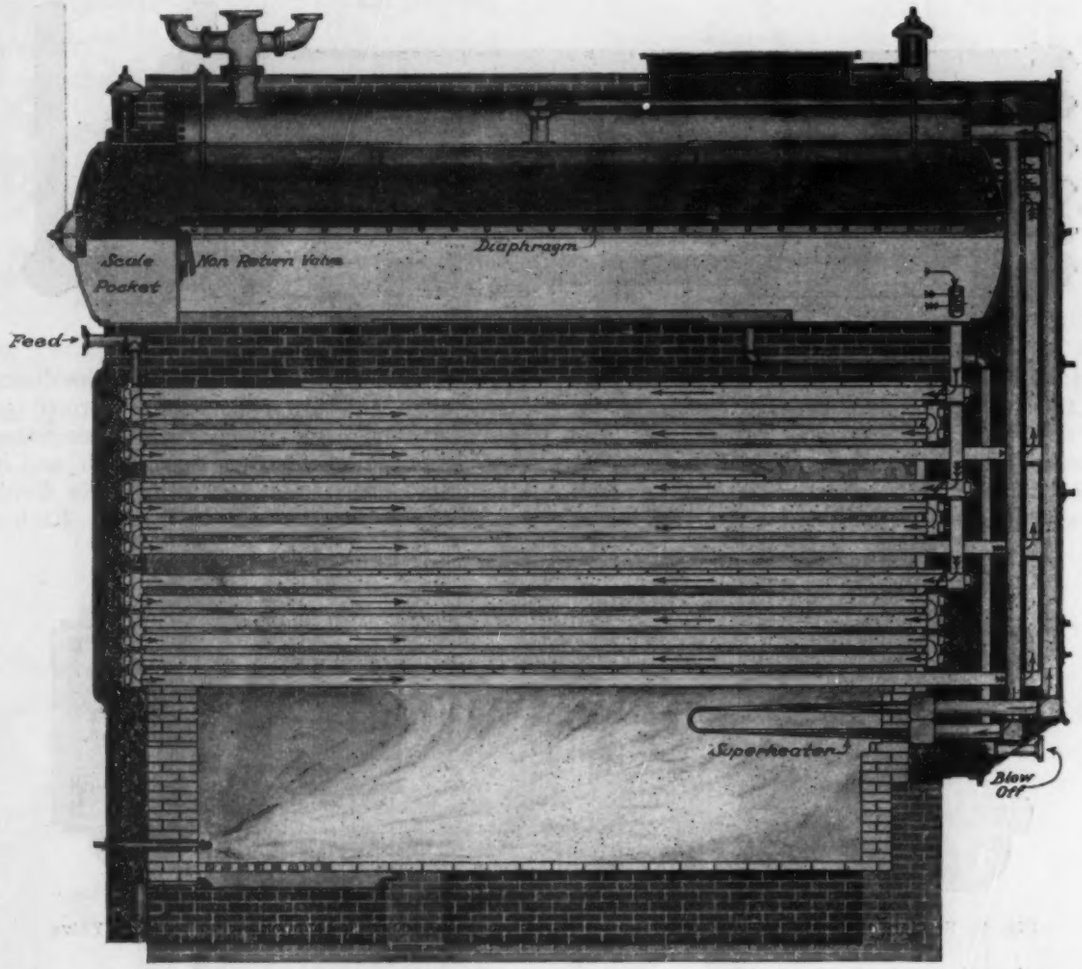


Fig. 1. Section of 645 H.P. Parker Boiler Showing Circulation of Water and Steam.

conclusively to confirm those of the earlier test and also to show that such performance could be repeated after a considerable period of operation.

The boiler tested is designated as boiler No. 2 in the above named power station. It is a Parker water tube boiler rated by the builders at 645 h.p. and designated as a compound 3 pass type; 2 wide lower elements and 4 wide intermediate. The boiler is 20 tubes wide and 14 tubes high. The tubes are 4 inches in diameter and 20 feet long. There are 2 drums 54 inches in diameter and 22 feet long. These are used for storing steam and water. There is one superheated steam drum 18 inches in diameter and 20 feet long. The steam and water drums shown in Fig. 2, are divided by a diaphragm of ¼ inch steel plate riveted to the shell. This diaphragm extends from the rear head to within a short distance of the front head where it terminates, and to this end, and to the lower part of the drum, is riveted a vertical steel plate forming the diaphragm head. Thus is formed a pocket at the front to collect the scale discharged from the tubes, the drum being thereby divided into two separate chambers. In the diaphragm head is a manhole to which a cover is hinged on the inside and when closed makes a water tight joint. The pivot on which this cover swings is at the top of the manhole, and the weight of the door keeps it closed when in normal condition. This swinging manhole plate acts as a non-return or anti-priming valve. Its function is to allow the water discharged into the upper compartment to enter the lower compartment of the drum but to prevent the return of water to the former. The upper section in the drum is known as the steam space, the lower as the water space. The bottom of the drum below the level of the nipples leading to the elements forms the sediment pan or mud drum. An inverted angle iron with closed ends is placed over the blowoff opening, thus making the blowoff effective over considerable area.

The tubes are divided into three banks, each bank forming a pass. The upper bank is known as the feed element and acts as an economizer, through which the feed water must pass before entering the drums. The intermediate and lower banks are termed steaming elements. The bank of tubes comprising the economizer is 20 tubes wide by 4 tubes high, and is in the third pass of the gases. This bank is divided into two elements 10 tubes wide by 4 high. Each of these elements discharges into the drum over them. The feed water enters the front end of the first tube in the elements, which are the upper wing tubes. At the rear of each of these tubes a connection, by means of an extended nipple, is made between the junction box and the respective drums. In this junction box is placed a non-return valve which prevents the feed from going the wrong way and entering the drum

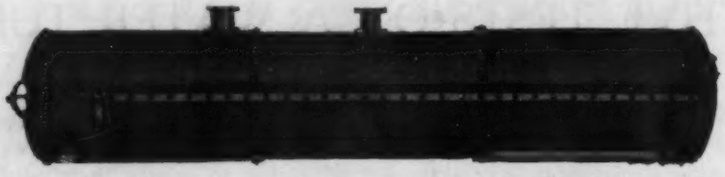


Fig. 2. Section of Steam and Water Drum Showing Diaphragm.

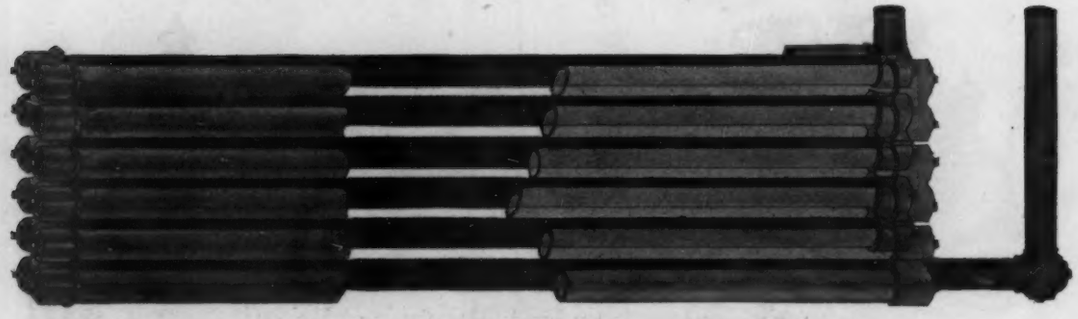


Fig. 3. One of the Evaporating Elements in First Pass.

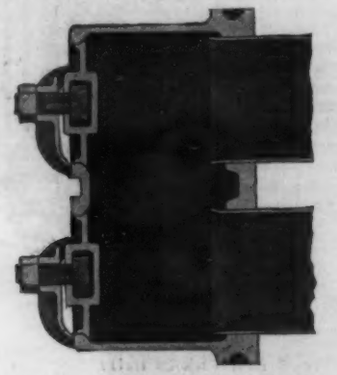


Fig. 4. Section of Junction Box.

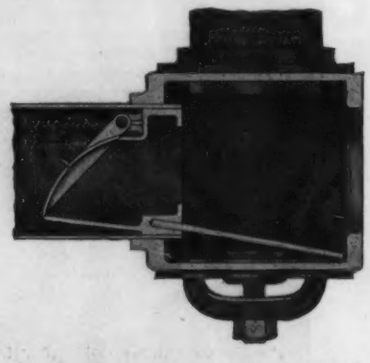


Fig. 5. Non-return or Check Valve.

through the inlet connection. The flow in the economizer elements is forward and backward alternately through the tubes in the top row; then, down to the next row and so on, finally discharging through two vertical upcasts into the rear head of the drum above the diaphragm. The water then flows along the diaphragm into the front pocket, though the swinging manhole into the lower or water chamber of the drum, from whence it flows by gravity to the steaming elements. If the feed is shut off, the drum connection furnishes the economizer elements with water.

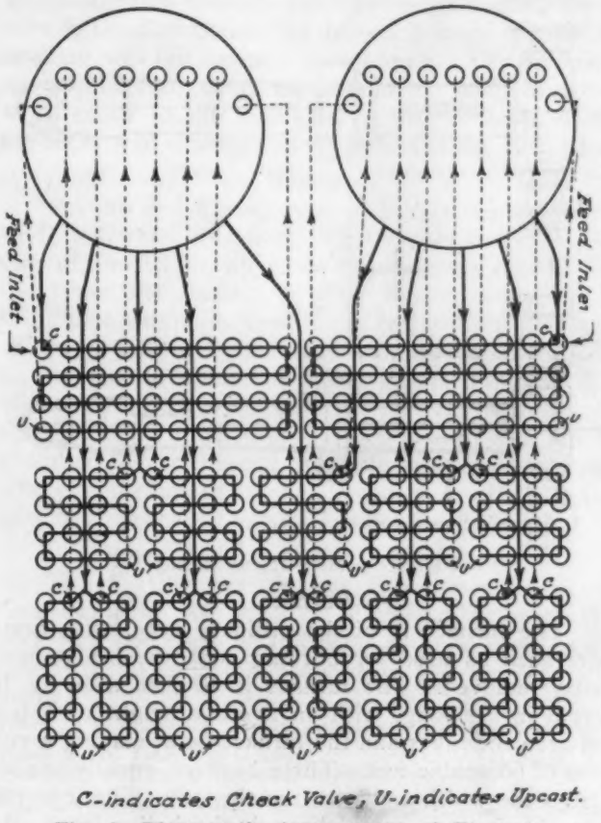


Fig. 6. Diagramatic Arrangement of Elements Showing Circulation of Water.

The intermediate bank of tubes is in the second pass of the gases and is composed of 5 elements 4 tubes wide and 4 tubes high. The water from the drum enters these elements on the upper or induction end through a downcast tube which is expanded in an inlet box which supplies two elements. Each element has a non-return valve in the inlet box which prevents the reversal of the flow of water. The water in these elements passes 4 times across, thence down to the next row and so on through the remaining tubes to the lower end of each element which is connected to the steam chamber by an independent upcast which discharges into the steam space of the drum.

The lower bank of tubes consists of ten elements, Fig. 3, 2 tubes wide and 6 high. The tubes in these elements, with the exception of the lower row which are in the furnace, form the first pass. The upper end of the elements are connected to the drums by means of down cast tubes and inlet boxes in the same manner as before mentioned. The water entering these elements passes across two tubes, thence down and across two tubes and so on to the last tube from whence it is discharged into the drum through an independent vertical upcast, connected to the lower end of each element. The elements are formed by expanding the tubes into junction boxes which hold two tube ends with a hand hole opening opposite each. The junction boxes, Fig. 4, have circular handholes, the covers of which are ground to the seat metal to metal, and, as the joints are made from the inside, the covers are held in place by the pressure.

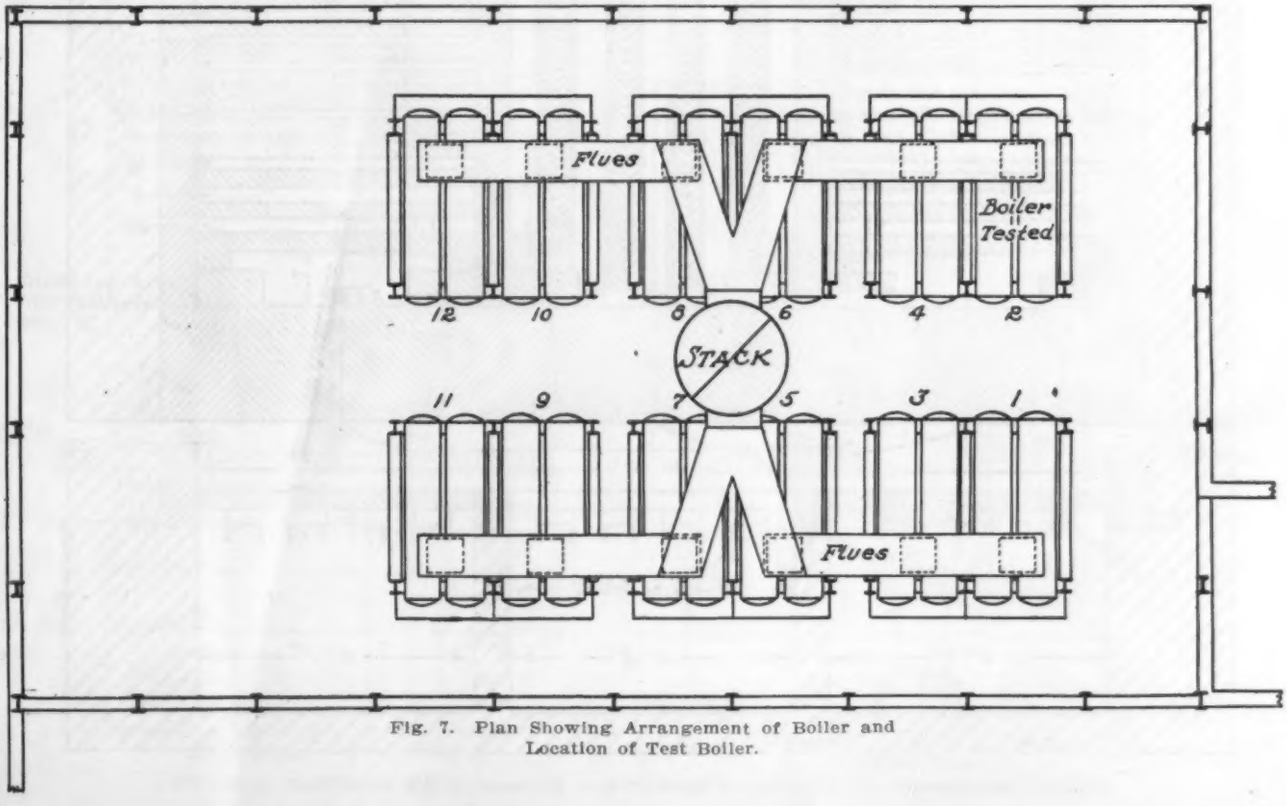


Fig. 7. Plan Showing Arrangement of Boiler and Location of Test Boiler.

The non-return valves, shown in Fig. 5, are fitted into the tube ends and are held in place by a loose pin which forms a positive stop when the handhole is closed. The valve is loosely hinged, has plenty of clearance and can be removed through the handhole for cleaning.

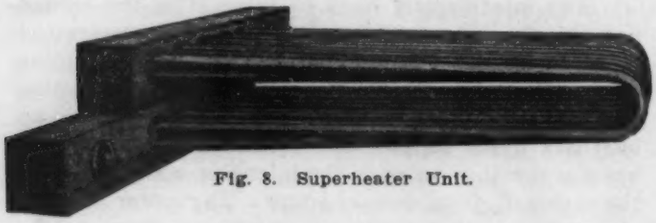


Fig. 8. Superheater Unit.

The steam is taken from the top of the drums by 5 inch tubes, one from each drum, to the bottom superheater header and after passing through the superheater tubes, (of which there are 32 loops with tubes 1¼ inches in diameter, bent in a U shape) passes into another header and is discharged through two 5 inch tubes into the superheater drum. The superheaters, Fig. 8, are located at the rear of the furnace below the lower row of tubes. The heated gases of combustion come in contact with the superheater heating surface at a high temperature, as only a small percentage of the heating surface of the boiler has been passed over by them before reaching the superheater. The superheater tubes are automatically flooded when the fires are extinguished and while raising steam from condensation in the superheater drums. The circulation and diagramatic arrangement of the elements are illustrated in Figs. 1 and 8.

Twelve of these boilers, arranged in 6 batteries, 2 boilers to the battery, comprise the entire boiler plant of this station. The general arrangement of the boilers is shown in Fig. 7.

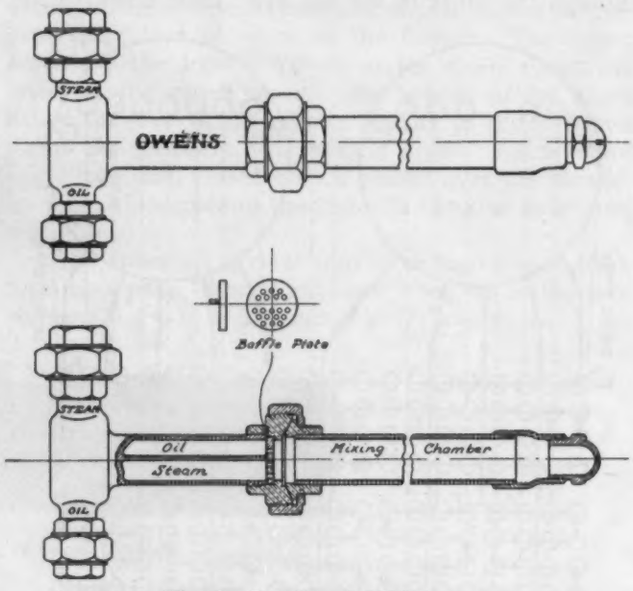


Fig. 9. Details of Oil Burner.

Furnace.

The furnace is of the ordinary type, with grate bars such as used for burning coal, the bridge wall being removed. The furnace is 10 feet wide by 16 feet 8 inches long, with an average height of 4 feet between the tubes and the furnace floor, making a volume of 666 cubic feet. Three burners, equally spaced across the width and with the tips extending 2 inches into the furnace enter through the boiler front. In front of each burner a rectangular space, 37 inches

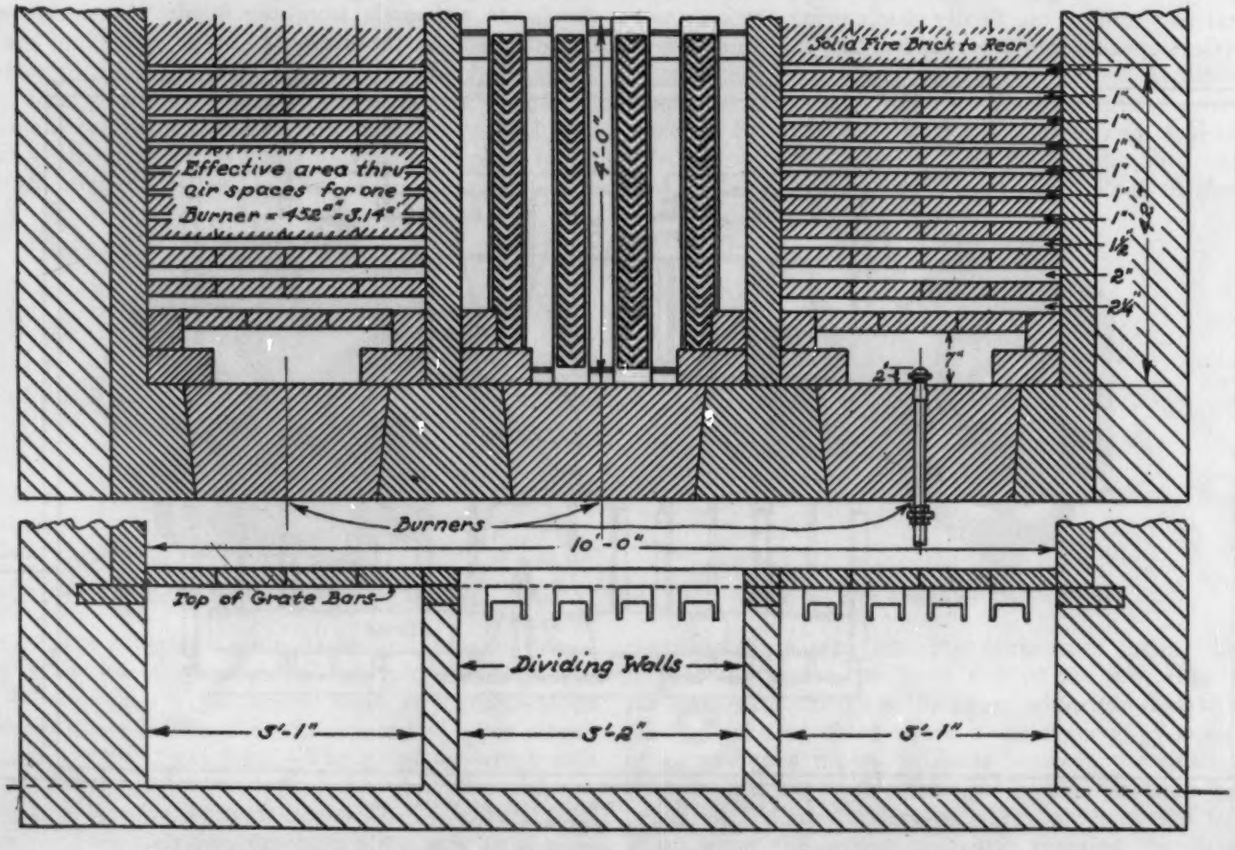


Fig. 10. Arrangement of Air Spaces and Grate Bars in Furnace and Dividing Walls in Ash Pit.

wide by 42 inches long, was left on the grate bars. In these spaces were placed soap fire-brick, laid in loosely and arranged so as to allow the admission of air for combustion through small openings running crosswise to the direction of the flame. A large rectangular opening was left beneath each burner. The ash pit is subdivided into three compartments, each of which supplies air to the individual setting for each of the burners. For arrangement and details see Fig. 10.

Burners.

An internal mixing type of burner, manufactured by P. J. Owens, was used. This burner is divided into two channels, the upper one containing the oil and the lower the steam. A plate having a number of small perforations is fixed to the end of these channels, the larger number or greater area of perforations being on the bottom where the steam passes through. The oil and steam, after passing through these perforations, enter a hollow tube or pipe which is used as a mixing chamber and at the end of which is a tip with a slot whereby the mixed oil and steam pass into the furnace in a fan shaped flame. For details see Fig. 9.

Water Heating Surface of the Boiler.

The heating surface was determined by actual measurement. All surfaces of the boiler in contact with water on one side and flame and hot gases on the other are taken into consideration and are tabulated below:

Tubes 4 in. diameter, circumference = 12.566 in. = 1.0472 ft.
Tubes 18 ft. long = 18 × 1.0472 = 18.85 sq. ft. of H. S.
Tubes 20 ft. long = 20 × 1.0472 = 20.94 sq. ft. of H. S.

HEATING SURFACE BOTTOM ROW OF TUBES.

20 tubes with 18 ft. of length exposed to gases = 18.85 × 20 = 377.00 sq. ft. = 6.20% of total

HEATING SURFACE 1ST PASS.

100 tubes with 20 ft. of length exposed to gases = 20.94 × 100 = 2094.00 sq. ft. = 34.5% of total

HEATING SURFACE 2D PASS.

80 tubes with 20 ft. of length exposed to gases = 20.94 × 80 = 1675.20 sq. ft. = 27.5% of total

HEATING SURFACE 3D PASS.

80 tubes with 20 ft. of length exposed to gases = 20.94 × 80 = 1675.20 sq. ft: = 27.5% of total

DRUMS.

2 drums 54 in. diameter, 18½ ft. of length exposed to gases Circumference = 14.1 ft. ½ of circum. 7 ft. = 7 × 18.5 × 2 = 259.00 sq. ft. = 4.3% of total

Total ..... 6080.40 sq. ft.

Superheating Surface.

The superheating surface was determined by measurement. The actual surface exposed to the gases on one side and steam on the other were measured. On the test of January 5th, there were 40 loops in the superheater; the exposed heating surface was 134.4 sq. ft. During the interval between this test and the one of March 18th the superheating surface was reduced by the removal of 8 loops, the remaining 32 loops having a total of 107.4 sq. ft. of heating surface.

Rating of the Boiler.

The builders' rating of the boiler is 645 h.p. On this rating is based the percentage of overload. The rate of evaporation per sq. ft. of heating surface is based on the measurements as tabulated above.

Quality of Steam.

The steam is superheated. Observations of the temperature of the superheated steam were taken with a standardized thermometer placed in a well located in the outlet from the boiler. The location of the well is shown in Fig. 11.

Apparatus for Handling and Weighing the Feed Water.

This consisted of 2 pairs of platform scales placed upon a staging. On these scales tanks were placed for weighing the water. The water, after being weighed, was emptied into a receiving tank beneath, from which it was delivered to the boiler by a special pump. A

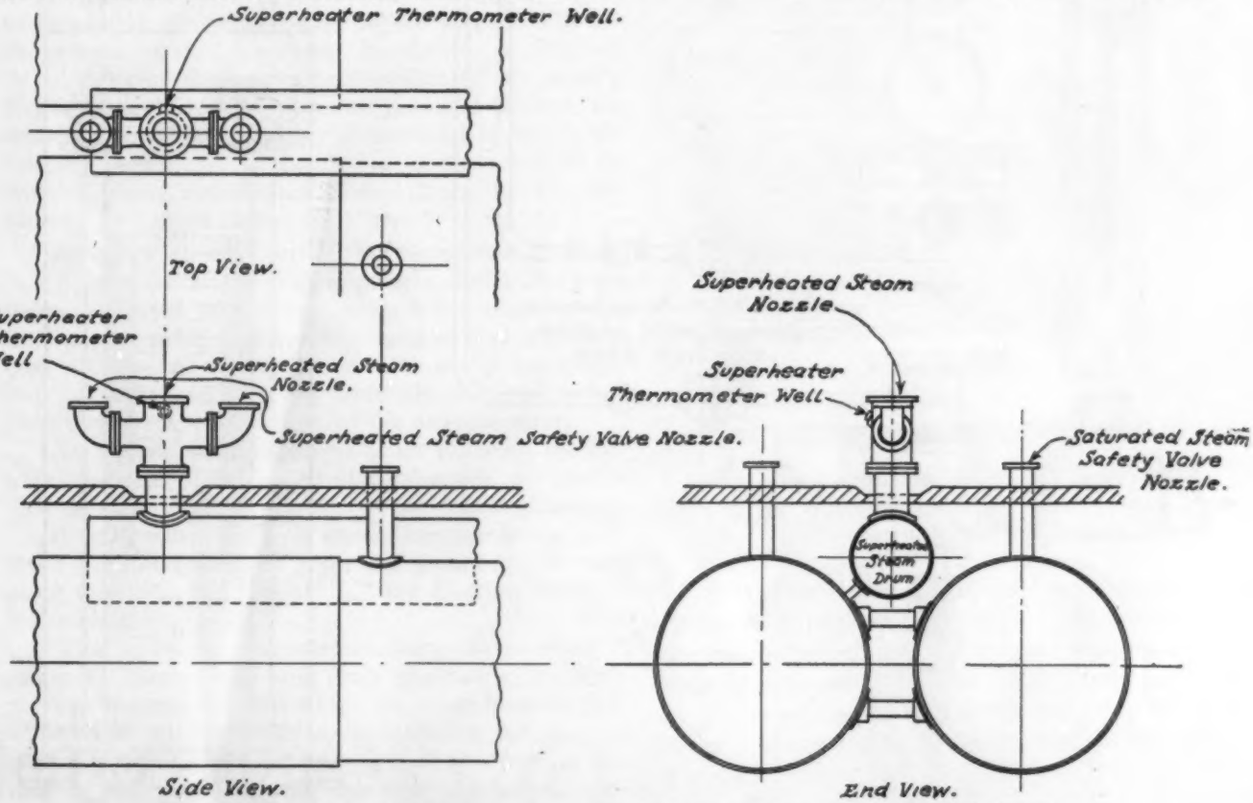


Fig. 11. Location of Thermometers for Reading Temperature of Superheated Steam.

hook gauge was placed in the receiving tank and at the beginning of the test the tank was filled so that the point of the hook just broke the surface of the water. This level was maintained at the end of each hour. The water in the boiler was maintained as near a level as consistent during the test. The outlets from the blowoffs were disconnected and blanked. The outlets from the water column and gauge glasses were carefully watched and no leakage occurred from either. At the end of each hour the actual amount of water was checked. The scales were standardized by representatives of the manufacturer.

Apparatus for Handling and Weighing the Fuel Oil.

This consisted of a standardized platform scale placed upon the same staging with those for weighing the water. Upon this scale was placed a tank into which the oil was pumped as required. From this tank the oil, after being weighed, was run by gravity into a receiving tank beneath, from which it was taken by a pump, passed through a heater and thence to the burners. This oil pump was fitted with a governor and an automatic relief valve. By these means a constant pressure was maintained in the oil line to the burners. The discharge from the relief valve led back to the tank from which the supply to the pump was taken. As the oil was emptied from the weighing tank, a small sample was collected, this operation occurring four times an hour. The samples collected represent a fair average of the quality of oil used during the test.

Heat Value and Characteristics of the Fuel.

At the completion of the test of January 5th the samples of oil collected were thoroughly mixed and divided into four portions. These were placed in small containers made of tin and sealed. One sample was delivered to the Southern Pacific Company, whose chemist made an analysis. One sample was used by the writer for analysis and the other two are in the writer's possession to be used for future reference if necessary. The results of the analysis by the Southern Pacific Company's chemist showed a lower heat value than that determined by the writer. For the test of March 18th, a sample was sent to Professor Edmund O'Neil, Dean of the Department of Chemistry of the University of California, Berkeley, for determining the heat value and water contained in the oil. As the writer's results were confirmed by those of Professor O'Neil the former only are given in detail in the present report. The writer's heat values were determined with a Parr calorimeter. Two determinations were made on each sample and the results averaged. The water contained in the oil was determined by distillation. The gravity was taken with a Westphal balance.

Steam to Burners.

This was superheated steam taken through an auxiliary valve on the nozzle attached to the superheater drum. The steam to the burner was measured during the test of March 18th. The method used for measuring this steam was as follows:

A diaphragm with an orifice .5 of an inch in area was placed in the steam line. On either side of this diaphragm holes were drilled and tapped for ¼ inch pipe. These pipes were connected to both legs of a

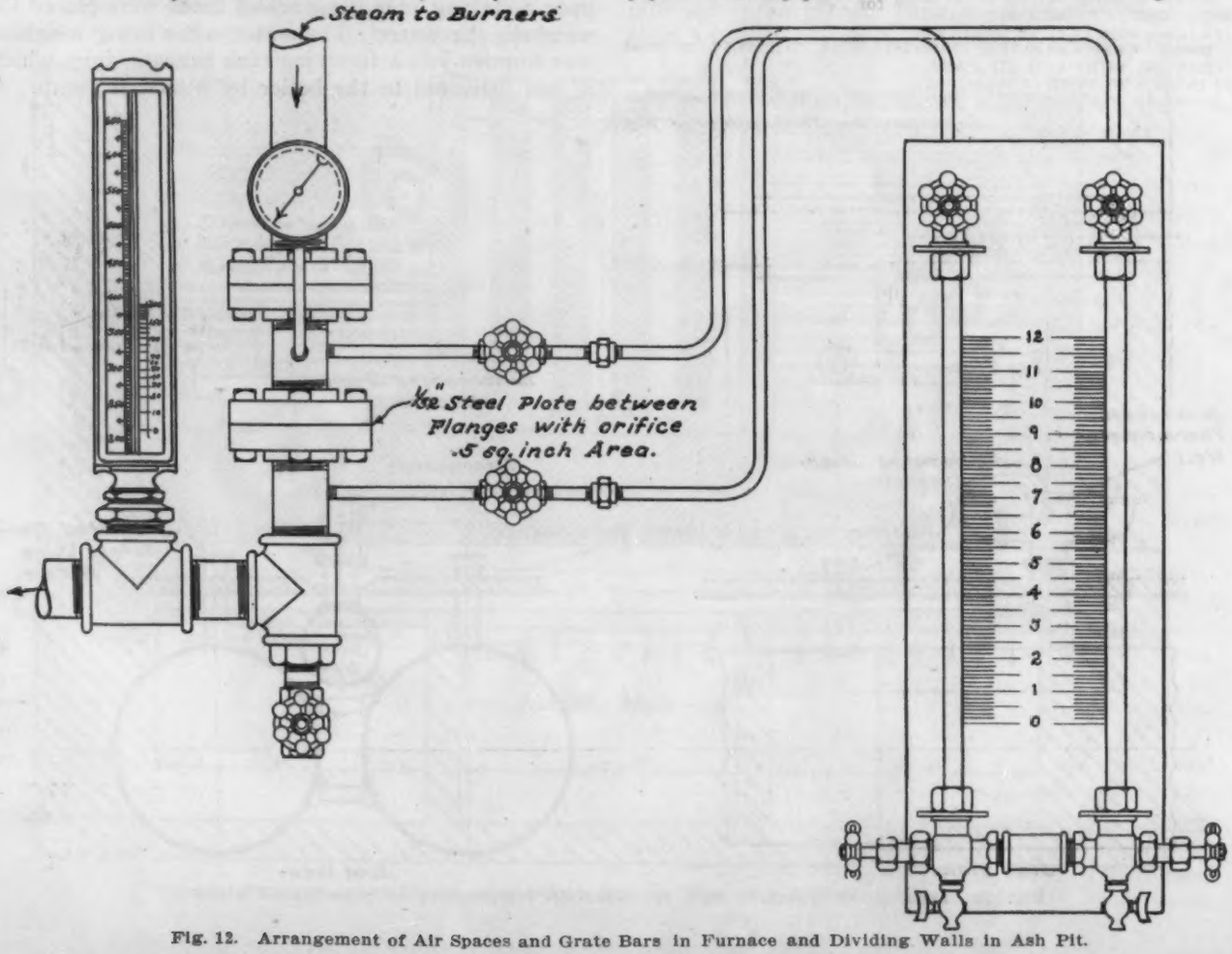


Fig. 12. Arrangement of Air Spaces and Grate Bars in Furnace and Dividing Walls in Ash Pit.

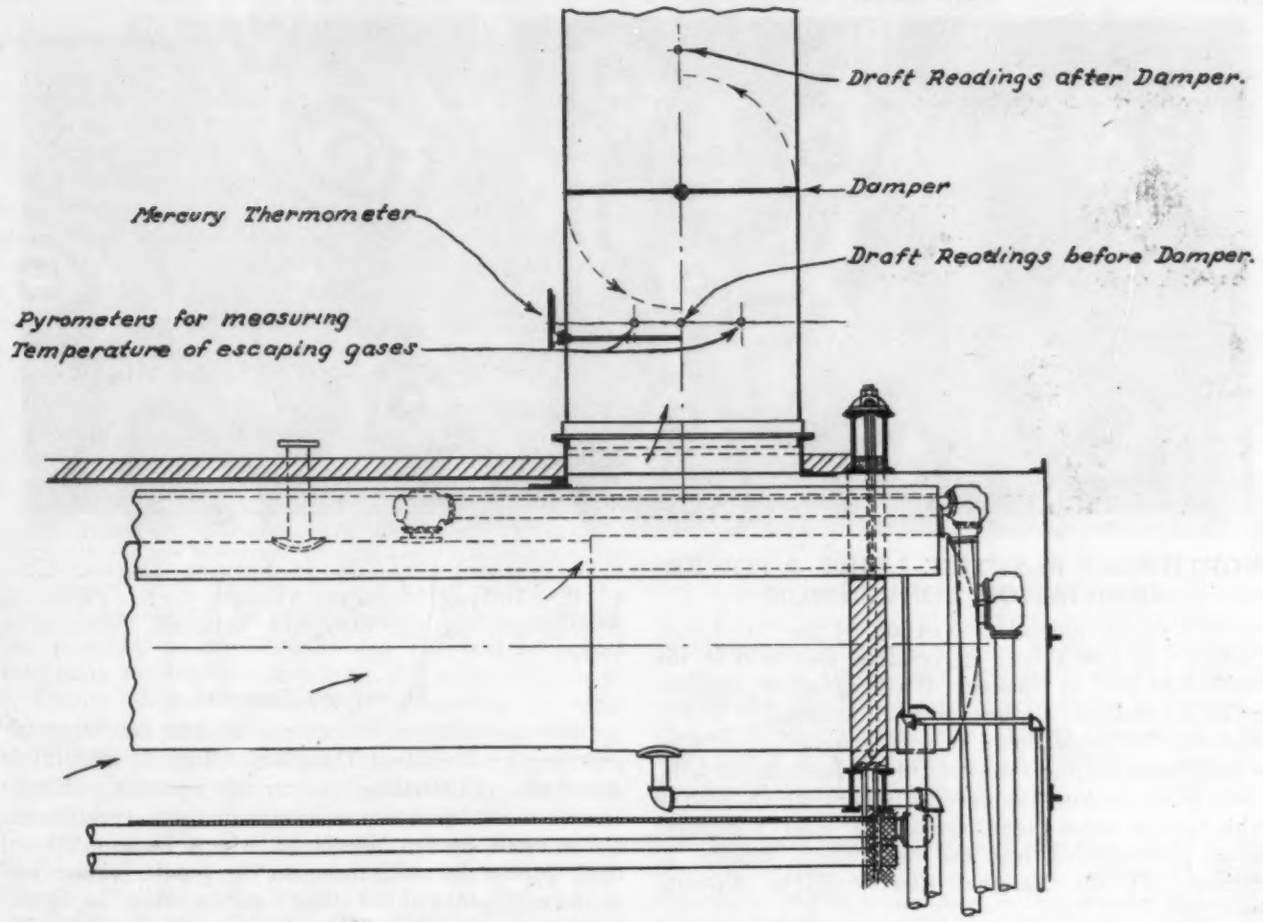


Fig. 13. Location of Pyrimeters for Taking Temperatures of Escaping Gases. Draft Readings Above and Below Damper.

manometer filled with mercury. In the steam pipe, ahead of the diaphragm, was placed a pressure gauge and beyond the diaphragm a thermometer was inserted to determine the temperature of the steam. The arrangement of this apparatus is shown in Fig. 12. After the test the orifice was calibrated by passing steam through under a series of noted conditions, the amount of such steam being determined by condensation and weighing. A tabulation of the principal results is given, also curves plotted from the data obtained. For these curves see Plates 9, 10 and 11.

General Plan of Test With Precautions Used.

All the thermometers and gauges used in the tests were calibrated and proper corrections made in the final computations. The boiler gauge was standardized with a dead weight tester. The scales for weighing the water and the oil were standardized before each test by representatives of the manufacturer.

To determine the amount of air entering the furnace, analysis of the gases of combustion for carbon dioxide were made by the use of the standard form of Orsat apparatus. Samples were taken where the gases leave the first pass and enter the second. The sampling tube was inserted at "L," the location of which is shown in Fig. 14.

The following observations were taken every 15 minutes. Steam, oil and draft pressures; temperatures of the superheated steam, steam to burners, feed water, fuel oil, boiler room, air entering ash pit and escaping gases. The temperature of the furnace and that of the gases passing through the boiler, were taken every 10 minutes.

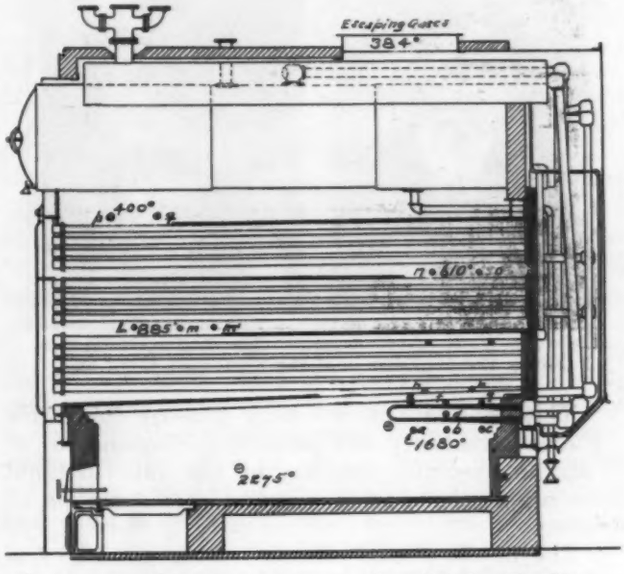
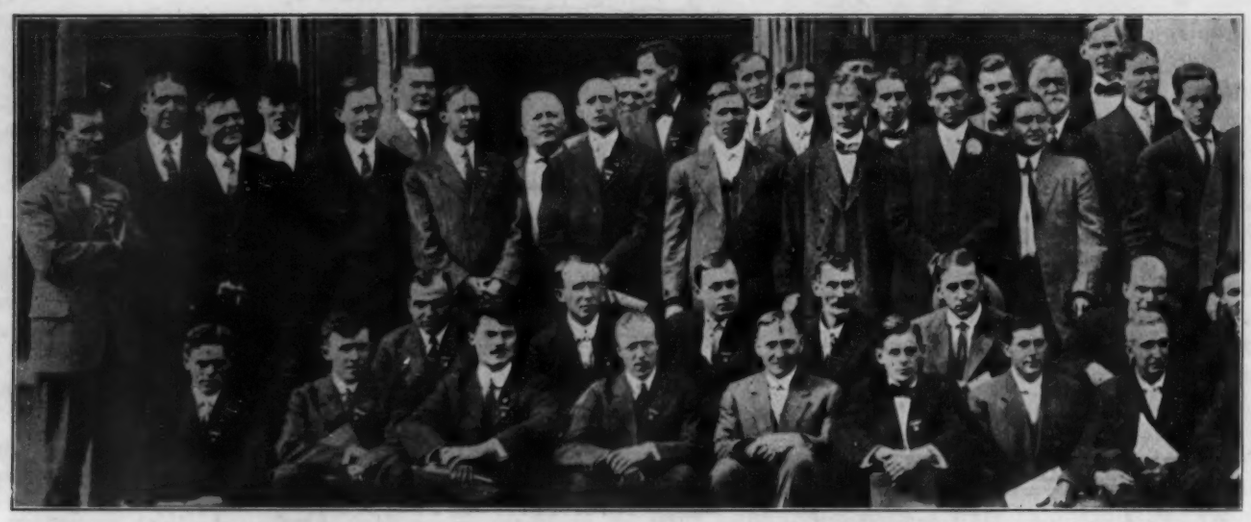


Fig. 14. Location of Holes for Securing Gas Samples, Temperature and Draft Data.

For determining the furnace temperature, a Fery's radiation pyrometer was used. The temperature of the gases through the boiler was taken with a Bristol electric pyrometer. Several couples were used, located at points where the gases left one pass to enter another. The location of these couples are shown in Fig. 14.

(To be continued.)



Delegates in Attendance at the Fourth Annual

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION CONVENTION.

The fourth annual convention of the Northwest Electric Light & Power Association was held in the "Hall of Doges" at Spokane, Washington, on September 21, 22 and 23. Both in point of attendance and in value of the proceedings it was generally conceded to have been the most successful convention yet held. Aside from reading the several papers which will be published in subsequent issues, the most important business transacted was the unanimous decision to affiliate with the National Electric Light Association.

Norwood W. Brockett, Secy. Jas. E. Davidson, Pres.
Newly Elected Officers of the Northwest Light and Power Association.

This decision was in a large measure due to the vigorous personality and persuasive eloquence of T. C. Martin, executive secretary for the National Light Association who was in constant attendance at all meetings.

The newly elected officers for the ensuing year comprise Jas. E. Davidson, general manager of the Pacific Power & Light Company at Portland, president; J. M. Kinkaid of the Port Townsend Light & Power Company, vice-president for Washington, George Hartley of the Lewiston Light & Power Company, vice-president for Idaho; Norwood W. Brockett, secretary of the Seattle-Tacoma Power Company, secretary and treasurer.

The executive committee consists of H. L. Bleecker, Spokane, Wash.; W. J. Grambs, Seattle, Wash.; Arthur Gunn. Wenatchee, Wash.; O. B. Coldwell, Portland, Ore.; M. D. Spencer, Eugene, Ore.; L. B. Faulkner, Olympia, Wash.; J. S. Thornton, Aberdeen, Wash.; Douglass Almond, Anacortes, Wash.

Thursday's Sessions.

The convention was called to order on Thursday morning by President Douglass Allmond, who introduced W. J. Hindley, mayor of Spokane. Mayor Hindley welcomed the members of the association in a few well chosen words in which he emphasized their duties and obligations in the public service and as the exponents of the great fiat "Let there be light." With regard to the relation between the municipality and the corporation he stated that as the corporation had prepared the soil, planted the trees and nurtured them until they bore fruit it was certainly entitled to a just return for the fruit.

Secretary Norwood W. Brockett in responding to this address of welcome, complimented Mayor Hindley on the broad fairness of his views, as the representative of Spokane's commission form of government. A vote of thanks was tendered Mayor Hindley by all present.

The report of the treasurer showed that the association was in a most prosperous condition, having gained eight new member companies and lost six because of consolidations. The association is more than self supporting and has a large bank balance.

As chairman of the committee on rates M. C. Osborn, commercial agent of the Washington Water Power Company, gave a detailed explanation of the system employed by the Washington Water Power Company, giving blackboard illustrations. This system, likewise, will be illustrated in a subsequent issue of this journal.

The afternoon session was opened with the report of the legislative committee which showed that during the past year a public service commission had been established in Washington, was pending in Oregon and had been vetoed by the Governor of Idaho, after having been passed by the legislature. An employees' compensation act was passed in Washington and its constitutionality is now pending in the Supreme Court.

J. B. Fisken then read his paper on "Problems of Power Transmission and Distribution." This was

Convention of the Northwest Electric Light Association.

followed by S. C. Lindsay's contributed discussion on the same subject. An open discussion then followed, the principal points covered were the use of leased telephone service on transmission lines, in addition to company telephone service; the grounding of wires to avoid loss and damage by lightning disturbances; the life of poles, cross arms, etc., and the preserving of native timber; cost of line construction; the forming of clubs by members of a company.

This discussion was followed by the paper of W. J. Grambs, Seattle, Wash., on "Central Station Publicity and Commercial Policy (covering general relations between central stations and the general public.) The meeting adjourned to Friday morning, September 2d, at 10 a.m.

Friday's Session.

Meeting called to order by President at 10 a.m.

The first item on the program was the reading of the paper of Arthur Gunn, Wenatchee, Wash., on "New Business Methods for the Small Central Stations."

In the discussion Fred Shields, of Moscow, Idaho, laid stress on the fact that the fixing of rates in small central stations was a different problem than that of the larger cities, as it was not as easy to explain a complicated rate to the small municipalities as to the larger cities. The matter of the extension of lines to outlying districts was also discussed and different experiences narrated. The securing of new business in the small towns was discussed and several interesting cases of the methods employed were outlined.

A. C. McMicken of Portland, Oregon, then invited the association to hold its next annual convention at Portland, Oregon. This matter was referred to the executive committee.

An amendment was then proposed to Article 4, Section 2, beginning at the fourth line thereof, inserting the words "The President shall not be eligible to re-election for two years after his term has expired." This was also referred to the executive committee.

C. N. Huggins of Portland, Oregon, then read his paper on "Methods of Accounting in Connection with National & State Legislation."

In the discussion that followed, it was strongly urged that a uniform system of accounting be adopted, also that a valuation of water powers be established, in other words, a method for appraising the water powers. The system of a uniform system of accounting would also obviate the necessity of reporting to two or three commissions, as is now the case in many instances. It was here moved that the president appoint a committee of five to make further researches into this important problem.

The next paper to be read was that of A. C. McMicken of Portland, Oregon, on "Central Station Problems." Discussion was deferred until the afternoon session.

T. C. Martin, executive secretary of the National Electric Light Association, was then introduced to the convention, and explained the advantages to be gained by the local association affiliating with the National. He assured them they would in no way lose their identity or state rights, and would be greatly benefited by the assistance received from the National Association in matters of pernicious legislation, and in the distribution of valuable literature. He showed where other minor association had benefited to a great extent by such affiliation and urged a like action by this association. The matter was referred to the executive committee for action.

S. E. Doane of the National Electric Lamp Association, was then introduced and addressed the convention on the lamp situation, stating that it was only a matter of time when tungsten lamps would universally take the place of carbon lamps and showing where this would be of benefit both to the central station and the consumer. He stated that these lamps would be supplied in low wattages within a short time, and also dwelt on the value of the rate committee and its work.

The meeting was then adjourned to executive session.

A committee was appointed, consisting of O. B. Caldwell, W. J. Grambs, J. M. Kincaid, T. A. McGowan and Mr. Hallowell to submit nominations for officers.

The matter of amending the constitution to include British Columbia was then taken up and referred to the executive committee.

The first matter taken up at the afternoon session was the discussion of Mr. McMicken's paper on "Central Station Problems." The question arose as to the advisability of extending lines where a set revenue was not guaranteed. That in the larger cities it was deemed advisable to endeavor to reach all consumers, even though a given income is not in sight, in as much as the franchise practically entitled the people to the service if desired; whereas, in the small towns and outlying districts it perhaps would be wiser to extend lines only where a given income could be realized. That the tendency not to build to prospective consumers in the cities, on account of excess cost, tended to create a feeling for municipal ownership.

The next paper was that of R. E. Thatcher, Seattle, on "Meter Accuracy in Relation to Central Station Income." He was followed by Mr. J. G. Finley, Spokane, who read an exhaustive account of conditions with the different companies in this regard.

Mr. H. M. Winter, Seattle, then read his paper on "Electric Heating & Kindred Uses of Electricity." There was no discussion.

Mr. Cheney of Seattle, one of the staff of the Washington Underwriters, was then introduced and addressed the meeting on the strong necessity that all wiring in small towns, without inspector service, be done with the utmost care, to eliminate fire risk. He stated they were now endeavoring to have the agents of the different light and power companies in these small towns appointed inspectors, to see that all electrical work was properly done. That the fire losses the past year were in excess of $300,000, between 6 and 7 per cent of which was attributed to electrical causes.

A motion was then made and duly carried that hereafter all papers be prepared and printed and delivered in the hands of the members of the Association at least thirty days prior to the convening of the annual convention. The meeting then adjourned.

Saturday's Session.

Saturday morning was devoted to consideration of Norwood W. Brockett's paper on "Legal Aspects of the Light and Power Business," and to a paper on the results of municipal ownership.

The next in order was the following questions submitted by C. H. Cleaver and answered by H. V. Gates, Hillsboro, Ore.

Question: What is the best method of supplying current to a town for light and power, current supplied by water power about one mile from town, to the amount of 100 h.p.

Answer: For first class construction from your power site to the generators, the line to your town should be built in a modern manner, using the very latest methods. It does not pay to engage in slipshod ways. If a.c. current, install generators to be determined as best suiting your needs, and any voltage from 2000 to 2300. If a timber country, poles to be set 150 ft. apart; if no timber 125 feet. For that amount of power No. 6 wire could be used.

Question: What is the best method of selling power, meter or flat rate; if meter, what system of rates?

Answer: Local conditions govern this to a great extent. From that size of a town (800), using 100 h.p., where only about ½ load would be carried, that flat rate would be more responsive to the net revenue of any rate you could use.

The meeting here adjourned to executive session, President Allmond, presiding.

The first matter to come before the executive session was the questions of affiliation with the National Association and the Executive Committee was asked to report on same. They unanimously recommended the affiliation, and the following resolution was unanimously adopted:

"That the report of the executive committee on the question of affiliation with the National Association be and the same is hereby approved and ratified, with the understanding that the present automony of the Northwest Electric Light and Power Association be retained and the power of collection of dues and other funds be fully retained by this association. The secretary of this association to remit to the National Electric Light Association an amount not exceeding one-half of the fees now charged by the national association, as such amounts may become due, this resolution to take effect October 1st, 1911."

Report of Committee on Amendments, Mr. Brockett, chairman:

First—That Section 2, Article 7, of the Constitution, be stricken out. That is the clause requiring the Class A members to be initiated. Hereafter, Class A members will not have to pay initiation fees.

Moved and seconded this amendment be adopted. Carried unanimously.

That Section 3, Article 7, be made to read as follows: The annual fee of Class B members to be $5.00, and strike out that portion of the section requiring initiation fees.

Moved and seconded this amendment be adopted. Unanimously carried.

Section 4, Article 7, to be amended to read: Annual dues of Class C members to be $5.00 instead of $4.00 as at present. We make this raise of $1.00 to conform with the Constitution of the national association.

Moved and seconded that this amendment be adopted. Unanimously carried.

Section 2, Article 3, motion to amend by adding the words "British Columbia."

Moved and seconded that this amendment be adopted. Unanimously carried.

Section 2, Article 4, fourth line theroef, insert the words "The President shall not be elected to serve for two years after expiring term." Moved and seconded amendment be adopted. Unanimously carried.

Motion now made that the president and secretary make formal application covering the affiliation of the N. W. E. L. & P. Ass'n., with the National Electric Light Ass'n. Motion duly seconded and unanimously carried.

A motion was here offered that the constitution of the N. W. E. L. & P. Ass'n. be amended so as to conform in all details with the requirements of the N. E. L. Ass'n., and that the inserting of the necessary clauses into this constitution be left in the hands of the committee on amendments, its power to be lim-

ited to the resolution already adopted. This resolution was promptly voted down.

According to the Constitution, the president appointed the secretary-treasurer for the ensuing year, naming Mr. Norman W. Brockett of Seattle to succeed himself. The convention then adjourned.

Social Features.

Sandwiched in between the business sessions were many delightful dinners and excursions. Aside from the various private parties, were the smoker and dinner to the thirty novitiates in the Rejuvenated Sons of Jove on Friday night, preceding the rejuvenation, and the great convention banquet on Saturday night. Incomplete returns show the following daring spirits as new members: B. Gustad and Lester M. Simpson of the Grangeville Electric Light & Power Company, Grangeville, Idaho; Thaddeus S. Lane, president of the Home Telephone Company, Spokane; D. F. Fearing, National Carbon Company, Cleveland; M. D. Spencer, Oregon Power Company, Eugene, Ore.; M. McGowan, Idaho and Washington Light & Power Company, Spokane; H. R. Williams, Stevens County Power & Light Company, Colville; Arthur W. Hillis, Montana Electrical Company, Butte; Lee F. Austin, Austin-McCain Company, Spokane; Clyde L. Bankson, Spokane & Inland; Frank O. Berry, Mosso-Berry Electrical Company, Spokane; William A. Davis, city electrical inspector, Spokane; C. G. Gilster, Washington Electric Supply Company, Spokane; James A. Gorman and Arthur C. H. Miller, Washington Water Power Company; Dare Headington, Miller Engineering Company; Harry A. Kinney, Mosso-Berry Electrical Company, Spokane; Mahlon McCain, Austin-McCain Company, Spokane; Millard Sebern, Washington Electrical Supply Company, Spokane; Fred M. Shields, Idaho-Washington Light & Power Company, Moscow; Vincent G. Shin-Washington Water Power Company; Hugh L. Tinling, Mosso-Berry, Electrical Company; Earl R. Warnes, Spokane & Inland; H. I. Bargoin, Washington Electric Supply Company, and Henry T. Whitehouse, Washington Electric Supply Company.

George Otis Gray of the Gray Investment Company is statesman of the Rejuvenated Sons for eastern Washington, and W. J. Grambs of Seattle occupies a similar position for the western part of the State.

Thursday afternoon the visiting ladies were the guests of the Washington Water Power Company on an automobile trip to the Spokane Country Club. This was attended by thirty guests and a delightful trip was experienced. Tea was served at the club house and a pleasant social afternoon was spent, the party returning to Spokane in the evening.

In the evening an informal ball was held at the Hall of Doges, Davenports. Seventy-five couples attended this function and disappointment showed on the faces of all present when the concluding number was played. At 11:30 lunch was served in the "Halls of Palms" and the merry laughter voiced the good time the entire party seemed to be having. The affair was admirably handled and an atmosphere of welcome and hearty fellowship pervaded the hall.

Friday evening was devoted to viewing Spokane by electric light, and all members expressed great surprise at the modern, up-to-date illumination of this city, the number of display windows and signs, and the substantial, high-class character of these signs.

Saturday evening the lady visitors were the guests of the Washington Water Power Company at a theater party; they attended in a body and the performance was greatly enjoyed.

On Saturday afternoon the visitors were the guests of the Washington Water Power Company on an automobile excursion "viewing" Spokane.

Saturday evening at 7:30, the closing banquet was held in the Hall of Doges, Davenport's, Spokane, about 125 members being present. The hall was beautifully decorated, a toothsome menu prepared, and one and all started in for a rousing good time. Mr. H. V. Gates, of Hillsboro, acted as toastmaster.

The banquet broke up at 12:30, everybody tired, but happy, avowing this to be the most successful convention in the history of the association.

Sunday, September 24th—visiting guests invited by the Washington Water Power Company to make an automobile inspection trip of the Long Lake and Little Falls plants. About 75 attended, all reporting a grand time and expressing surprise at the Washington Water Power Company's immense undertaking at these points.

Among those who registered were:

Douglass Allmond, Anacortes Water Co., Anacortes, Wash.; C. R. Andrus, Pasco Power & Light Co., Pasco, Wash.; Thos. G. Aston, Washington Water Power Co., Spokane; B. P. Bailey, Pacific Power & Light Co., The Dalles, Ore.; A. H. Beckwith, G. R. Beekman, H. C. Billice and M. W. Birkett of the Washington Water Power Co.; Norwood W. Brockett, Seattle-Tacoma Power Co., Seattle; C. L. Cleaver, Granite Falls Power & Light Co., Granite Falls, Wash.; W. R. Chrysler and G. M. Corey, W. W. P. Co.; O. B. Coldwell, Portland Ry., Light & Power Co., Portland; Darrel Corbett, Chas. C. Moore & Co., Engrs., Seattle; J. E. Davidson, Pacific Power & Light Co., Portland; S. E. Doane, National Electric Lamp Association, Cleveland; H. B. Dunn, Seattle-Tacoma Power Co., Seattle; Eugene Enloe, Big Bend Light & Power Co., Spokane; A. R. Fairchild, W. W. P. Co., Spokane; F. R. Fantorn, W. W. P. Co., Colfax; D. F. Fearing, National Carbon Co., Cleveland; W. W. Ferris, Grays Harbor Railway, Light & Power Co., Aberdeen, Wash.; J. G. Finley, W. W. P. Co., Spokane; H. C. Fiske and J. B. Fisken, W. W. P. Co., Spokane; J. G. Flynn, Portland Railway, Light & Power Co.; C. S. Foster, W. W. P. Co., Spokane; H. E. Gates, General Electric Co., Spokane; H. V. Gates, Hepner Light & Power Co., Hillsboro, Ore.; W. J. Grambs, Seattle Electric Co.; F. F. Griffin, W. W. P. Co., Spokane; Arthur Gunn, Wenatchee Valley Light & Power Co., Wenatchee; Albert S. Hall, Pacific Power & Light Co., Hood River, Ore.; L. W. Harper, Chelan Water Power Co., Chelan, Wash.; Arthur H. Halloran, Journal of Electricity, Power & Gas, San Francisco; D. F. Henderson, G. H. Hoppin and H. W. Howard, W. W. P. Co., Spokane; C. C. James, Seattle Electric Co., Seattle; J. J. Jennings, Lewis-Clark State Improvement Co., Lewiston, Idaho; J. D. Jamison, Westinghouse Electric & Mfg. Co., Spokane; Blaine L. Renio, Westinghouse Electric & Mfg. Co.; S. C. Lindsay, Seattle Electric Co., Seattle; C. F. Kirckhain, Seattle Electric Co., Seattle; J. M. Kincaid, Port Townsend Light & Power Co., Port Townsend; Charles Kolb, Wilbur Electrical Co., Spokane; H. R. Kriegman, Pacific Power & Light Co., North Yakima, Wash.; J. W. Leighton, Holabird Electric Co., Seattle; Chas. H. Lund, W. W. P. Co., Spokane; H. H. Levin, W. W. P. Co., Spokane; G. W. Longmeir, Pacific Power & Light Co., Prosser; Lewis A. Lewis, W. W. P. Co., Spokane; C. S. MacCalla, W. W. P. Co., Spokane; T. A. McGowan, Idaho & Washington Light & Power Co., Spokane; A. C. McMicken, Portland Railway, Light & Power Co., Portland; D. C. McKissick, Northwest Light & Water Co., Wallace, Idaho; T. C. Martin, National Electric Light Association, New York; G. A. Martin, Yamhill Electric Co., Newberg, Ore.; W. G. Martin, Bremerton Light & Fuel Co., Bremerton, Wash.; B. M. Merrill, W. W. P. Co., Spokane; V. C. Naylor, Pacific Power & Light Co., Goldendale; F. D. Nims, Western Canada Power Co., Vancouver, B. C.; C. P. Osborne, Portland Ry., Light & Power Co., Portland; M. C. Osborne, W. W. P. Co., Spokane; C. E. Parkes, W. W. P. Co., Spokane; H. B. Pierce, W. W. P. Co., Spokane; L. J. Pospisal, W. W. P. Co., Spokane; W. D. Roe, Wilbur Electrical Co., Wilbur, Wash.; F. L. Rohrbach, W. W. P. Co., Spokane; C. Rumwell, B. C. Electric Ry. Co., Vancouer, B. C.; Geo. S. Sanderson, Pacific Power & Light Co., Freewater, Ore.; Chas. A. Sind, W. W. P. Co., Spokane; O. Skiles, Pacific Power & Light Co., Sunnyside; M. D. Spencer, Oregon Power Co., Eugene; A. V. Stirling, W. W. P. Co., Spokane; R. E. Thatcher, Seattle Electric Co., Seattle; H. V. Tompkin; R. E. Tompkins, W. W. P. Co., Spokane; C. A. Turlay, Portalnd Ry., Light & Power Co., Vancouver, Wash.; H. A. Turner, Seattle Electric Co., Seattle; C. F. Uhden, W. W. P. Co., Spokane; G. W. Uzzell, W. W. P. Co., Spokane; E. A. West, Portland Railway, Light & Power Co., Portland; Thos. W. Weill, Kootenai Power Co., Coeur d'Alene, Idaho; H. R. Williams, Stevens Co., Power & Light Co., Colville, Wash.; J. S. Wurtall, W. W. P. Co., Spokane; H. M. Winter, Seattle Electric Co., Seattle.

PACIFIC COAST GAS ASSOCIATION.

The two following papers, the one by C. S. S. Forney, president of the Southern Counties Gas Company, and the other by C. M. Hunt, manager of the San Diego Consolidated Gas & Electric Company, were read before the recent Oakland convention of the association:

HIGH PRESSURE GAS DISTRIBUTION.

BY C. S. S. FORNEY.[1]

The service furnished to towns, villages and rural communities from the central generating station by high pressure trunk lines may be considered as suburban gas distribution.

The problems in connection with this work as to engineering and construction features are simple and direct and have a multitude of precedent and example to fortify and confirm the theories which any engineer will evolve by consideration of the cases presented.

The financing and organization of a company for this work required bold conception and conservative execution if the proposition involves the acquirement of existing properties and the linking and grouping together of towns previously served by unit generation.

The operation of such a property necessitates an unusual quality of supervision, because the properties are not under the eye of the management to the extent that single large plants and distributing systems are, and the employees are more removed from the direct influence of the management.

The logical method of estimating a system for suburban gas distribution by high pressure mains is to consider the ultimate territory to be served in its various aspect as a whole. This can be arrived at best by considering the towns which ultimately may be a part of the system even though there may be a number of other companies operating in the territory; as to conceive a project, it is necessary generally to disregard the existing conditions.

After determining the towns which may be served by a general system, the buildings in the various communities and in the suburban districts should be counted. Estimates based on population are usually arrived at by allowances for this, that, and the other condition, after assuming that so and so will happen or not happen, and if so and so does happen, it may result in something else.

The logical method of determining the number of its consumers in a given district is to have the houses and other buildings counted and segregated into two or three classes; that is to say, houses of a value of $3000, or less, and houses of a value of more than $3000 and where it is intended that commercial lighting shall be done, a separate segregation of the number of stores should be made and one classification of other buildings should include churches, public buildings, schools, etc.

There should be considered the ultimate development of the territory, based on prediction of what the conditions will be in ten years. This can be arrived at in a number of ways, but the best method is to take the number of acres of tillable land tributary to a certain town and consider the probable ultimate development of the area; that is to say, to consider whether it will be divided into small ranches, large ranches, towns, cities, etc., and where, as in Southern California, we have horticultural and agricultural development of high degree, consider how many acres of the highest class; orange groves, walnut groves, etc., have been developed to produce a certain sized town and then next to consider how many acres may be developed to the highest form from some of the lower classifications, and then determine what sized town will be produced thereby.

The relation of the size of the town of the inferior classes of farm development, should then be next considered and the two will result in a basis for predicting what the ultimate size of the town will be, based on the ultimate development of the contributory factors.

Other things may have to be considered, as the development of a seaport, the building of new lines of railroad, to what extent the town is dependent upon the adjacent farming developments and the result from its being suburban to some large community.

After these various factors have been studied and determined, the number of gas meters in service in 1920 should be assumed at being 90 per cent of all the buildings.

After determining the number of meters probable in the territory to be served by 1920, a basis of $100 per meter should be used to determine the capitalization required by the company in forming a company to serve a given territory. It is desirable to have a certain fixed relation between the various classes of capitalization; $150 per meter being the capital value of a gas property, the proportion of capital which represents the actual physical value of the property should not exceed 80 per cent thereof; the remaining 20 per cent representing intangible assets. This relation will be referred to subsequently in this paper.

In view of the new thought movement, which is so seriously and vitally affecting public service corporations, it seems desirable that the corporation should receive its charter from the State in which it is operating, to the end that, if conditions work a hardship under these circumstances, then that much sooner will the conditions be corrected.

There should be a straight line drawn between the securities which are sold for the purpose of raising money for the corporate needs of a company and those securities which are taken and held either for controlling purposes or as compensation for development and management. An excellent way to secure the effecting of such a plan is to arrange to escrow the stock to be sold with a trustee, under the terms of an agreement providing for the issuance of the stock under certain conditions.

After all of the foregoing has been considered and determined the next matter to undertake is to consider what arrangement would be made to serve the territory in the event that there were no gas plants now operating. Then consider and determine what arrangement would be made to serve the territory in the event that there were no gas plants operating in 1920.

After these two things have been determined co-

[1]President of Southern Counties Gas Company.

relate the two so that there will be a minimum loss in discarding existing plants. After determining the plant situation in 1920, the high pressure trunk line should be laid out with an idea of carrying the load at 40 pounds pressure, based on the amount of business in 1920.

The next problem involved is to fit the existing manufacturing plants into the trunk line system.

If the plan is well worked out, logically designed, and sound economical and engineering reasoning used, the problem of securing capital for the carrying out of the plan would be solved, if people were eager to bid for an opportunity to participate in 6 per cent regulated public service corporation securities.

The company with which the writer is connected, Southern Counties Gas Company of California, has approximately 6000 meters served by high pressure trunk lines, and high and low pressure distributing systems.

The high pressure trunk lines are at present operating under a pressure of 20 pounds, and at higher pressure are designed to supply the particular groups of towns served, for ten years to come.

We have shut down three small plants, but maintain them as a reserve against possible interruptions in sections of the high pressure mains. Eventually it is hoped to have the entire system served by two plants, operating at each end of the through trunk line, a distance of about seventy-five miles. When this condition is reached and the line completed, the system will be serving about 12,000 consumers.

By moderate pressure in the mains of 2 pounds, with individual regulations, we find that we are able to cut down our maintenance labor 50 per cent.

We are operating seventeen towns and maintain an office in each one. In some of the smaller towns we arrange with a local druggist to represent the company; and in the event of trouble complaints, or break downs, advice is telephoned to one of the given offices where an attendant is stationed, and from which the work of a particular group of consumers is handled.

Other economies have been effected by shutting down of plants, in labor and in fuel oil.

We have brought much suburban territory in touch with transmission lines, from which lateral have been run into sparsely settled district, making it possible to supply small isolated communities, which would not have had gas service otherwise for a long time to come.

The compression of gas has made possible its delivery to remote sections, with comparatively small mains, making it possible to consider favorably extensions which have heretofore been impracticable.

This class of distribution, however, represents comparatively high maintenance and operating cost, as the meter reading and collection of delinquent bills under such conditions involves considerable expense for transportation, and loss of employees' time in transit.

It is our practice to use only 1500 pound test line pipe on 2 inch, and larger, and we specify that the couplings should be hand set at the factory.

In laying these mains we grade a ditch with almost as much care as though we were laying low pressure mains. At the time of laying, the couplings are unscrewed and liberally coated with red lead, then reversed, and in practically 70 per cent of the connections we find that we are able to utilize all of the thread on the pipe, thus making our connections good from a friction standpoint as well as a mechanical standpoint. We have a large, portable air compressor with which we fill the mains with air up to 100 pounds pressure. Each joint is then carefully tested with soap suds, and we have reason to believe that our lines are as well laid as possible.

We insert expansion joints in the line at various points, such as river crossings, corners at the end of long sweeps, etc., and also provide the line liberally with valves.

Our expansion joints and valves are set in concrete boxes with cast iron man hole covers, similar in design to those used in conduit work in cities, but smaller in size.

Suburban gas distribution is growing in importance each year, especially in Southern California, where the trend seems to be toward ten-acre ranches. In our Southern Division, supplying the cities of Santa Ana, Anaheim, Orange and Fullerton, we have a generating plant at Santa Ana, serving the entire district.

The high pressure trunk line is 4 in. in diameter and is 12 miles long, and carries gas under a pressure varying from 10 to 20 pounds.

This territory included a population of about 25,000 people, formerly supplied from four plants. This particular group of towns offers an excellent opportunity for this class of work, and it might be termed "Intensive Suburban Distribution."

From Santa Ana, with a population of 10,000, it is a distance of three miles to Orange, with a population of 5000; from Orange it is a distance of four miles to Anaheim, with a population of 5500; from Anaheim it is a distance of three miles to Fullerton, with a population of 3500; while along the road traversed by the high pressure trunk line, there are about 20 houses to the mile.

The gas for this section is manufactured at Santa Ana and compressed through receiving tanks to a high pressure trunk line, which is 4 inches in diameter the entire distance.

The eventual plan on this particular group is to extend the line a further distance of thirteen miles to Whittier.

The high pressure line, as it passes through Santa Ana, is utilized to serve certain sections by district regulators.

At the plants which have been shut down, the holders are kept full and held in reserve in case of interruption of service furnished by the high pressure trunk line; small compressor plants being maintained to utilize the gas stored.

In all high pressure work the installation must be made with the greatest care and with the utmost precaution, as small breaks, such as a plowed up service, may result in a great deal of loss of gas before the pressure can be shut off.

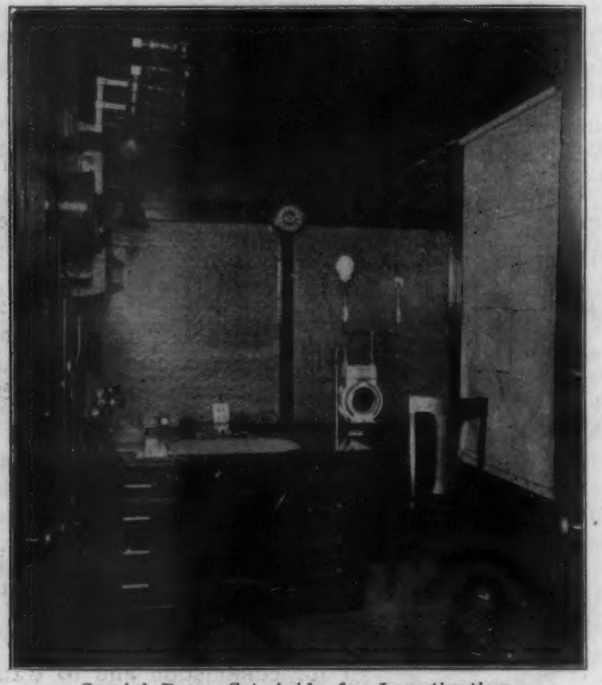
The development of high pressure gas distribution has resulted in operating economies, in securing better pressure conditions, and has enabled us to serve customers not otherwise available.

OUR INVESTIGATING DEPARTMENT.

BY C. M. HUNT.[1]

The investigating department of a public service corporation of to-day is not the chamber of horrors it was some three years ago. The public have rights which we gladly respect. The policy of this department is to shape its attitude as regards the public so that the patron is bound to feel that by simply calling attention to a real or imaginary wrong it will receive prompt attention.

I feel that the patron making a complaint is honest in the belief that a wrong exists which, from his point of view, needs immediate attention from this department, and we attempt to give that complaint immediate attention, and a full and complete investigation is had. I cannot bring myself to feel that even though the claim be an insignificant one it can be passed without a full and complete investigation, as it is the little things that are noticed in corporations and, odd as it may seem, I do not believe that the general public intends to impose upon this department.



Special Room Set Aside for Investigating Department.

Now, as an investigator, I do not take the position that I am at liberty to make a patron feel as if he or she were upon the witness stand when stating his or her complaint, and that I or the investigator were taking him through a strenuous cross examination in the effort to have him admit that his claim to poor service, or even a disputed account, or the like, was not well based.

I believe, too, that the matter of the mode of transmission of either gas or electricity for their burners and lamps should be fully understood by them, and I have always taken pleasure in making full and complete explanations whenever a patron showed an interest and made inquiry in reference thereto.

I feel too, that the matter of a patron being able to read his own meter is of importance, and the mechanism of a meter should not be shrouded in mystery, but the contrary. A patron should be given full insight into the the same and I for one attempt to instruct them in meter reading and for that purpose have prepared devices whereby they may take up the study of meter reading and, so far, have been successful, and now among our patrons find many housewives who as consumers are able to read their gas and electric meters. Heretofore a meter was looked upon as a puzzle made only for the purpose of defrauding the public and not for the purpose of showing its consumption. Along that line, that is for the instruction of the general public, we have installed in the investigating department of this company, not alone for our own edification, but, as I have said, for the benefit of the public, the following equipment:

A gas meter with glass front and back, showing its complete mechanism. To this meter we have attached one ordinary open gas jet and a mantle burner. Between the meter and the burner are gauges showing the consumption per hour, thus enabling us to show the customer the difference in the amount of gas consumed on these burners, and it is surprising to know that many disputed bills have been settled satisfactorily by this comparison.

We have also a Jones jet photometer showing the candle-power of our gas, also a water column pressure gauge which shows our gas pressure.

We also have an electric recording volt meter, a regular type I electric meter with glass front showing mechanism of same.

To bring about comparisons in electric lighting, we have bars upon which are placed electric lights, the upper bar showing the various sizes of carbon lamps and the bar underneath showing the various sizes of Mazda lamps. To this we have connected a watt indicating meter with a special dial which indicates the amount of current consumed per hour on any of the lamps displayed on the bars spoken of. This special dial is based upon the rate upon which we sell our electric current; namely, 10 cents per kilowatt hour.

Along these lines, I should like to say that this device, as well as the demonstrating gas meter has done as much or more to adjust claims of dissatisfied customers than all the talker or writer might do, as it is self-explanatory and demonstrates to the customer what words have failed to do.

I have attached photographs showing views of the interior of this office.

I also append a copy of our investigating order. The body of this order covers all possible complaints as well as the mode of investigating the same, by whom, at what time, time consumed, and various other important items. At the bottom of the order you will note report of workmen, showing time of receipt of order by him, when executed and when returned to this office. On the reverse side you will note a detailed report, not only showing the conditions as he finds them, but the equipment and appliances of the house and also any suggestions which he might make which would better the service.

A report of this kind returned to this office puts

[1]Manager San Diego Consolidated Gas & Electric Co.

us in direct touch with the facts concerning the complaint and at the same time aids in our load record.

After installing this system of investigation and giving the same due and thorough trial our complaints have decreased very materially as is shown by the following statement: In the last two years the complaints have fallen off from 5 per cent down to ½ of 1 per cent of our customers and this too, notwithstanding the fact that our increase on meter sets has raised from six thousand to twelve thousand.

It must be borne in mind that in this department we have to deal with complaints of high bills, poor service, gas leaks, setting or removing meters, re-reading of meters, opening and closing of accounts, testing meters and answering by letter of every complaint entered in this office after the order which has been issued thereupon is returned to the writer. Now this letter explains to the customer just what the conditions were as reported, and it is not a stereotyped letter, but deals with each individual complaint and is signed in person by the writer.

Emergency Instruments in Investigating Department.

In order to meet the demands and take care of the orders that are entered in this office we have a force of day men as well as night men. The night force on the electric side consists of one night man mounted on a motor cycle and one with an automobile. For the gas we have two gas night men with steam automobile, equipped with all necessary tools as well as 100 feet of hose which can be utilized in case the service line is choked. These men also carry extra meters. Their office is equipped with a complete telephone system, thus putting the public in touch with them at all times. These men make their report before going off duty in the morning, thus putting this office in touch with what transpired during the night.

In conclusion I wish to say that it is the effort of this department to give the public not only satisfaction but perfect service, and that it is not only the method and manner in which this is handled and what is said as much as the way in which it is said and the courteous treatment that our patrons receive that is the primary cause of our success—if we are successful—our precept being that courtesy is a cheap commodity, and that we attempt to be men among men.

PRIMER OF APPLIED THERMODYNAMICS.

Sixth Lecture.

Boiler Efficiency and Factor of Evaporation.

In our last lecture we looked somewhat into the theory of perfect gases, and found the laws under which they act and the consequent engineering computations which can be made. Before entering deeper into considerations of work and other thermodynamic relationships, it will be well for us to go back again to our studies in combustion, and still further see how the heat is made use of after combustion takes place. We have found that where 1 lb. of pure carbon is converted into carbon dioxide, 14,600 B.t.u. are liberated. and in the formation of carbon monoxide only 4450 B.t.u are given out. Hence if

W = weight of gas formed per lb. of carbon,

K = mean specific heat,

T — t = elevation of temperature produced, then

$$T - t = \frac{14{,}600}{W\,K}$$ for combustion to carbon dioxide, and

$$T - t = \frac{4450}{W\,K}$$ for combustion to carbon monoxide.

Hence it is evident that if too much air is supplied to the furnace, although all of the carbon may be burned as carbon dioxide, yet the cooling effect brought about by enlarging W will reduce the temperature. On the other hand, when too little air is admitted, carbon monoxide is formed instead of carbon dioxide, and again the temperature is not only lowered but much heating value of the coal or fuel goes out of the stack. The amount of air theoretically required to burn one pound of coal is

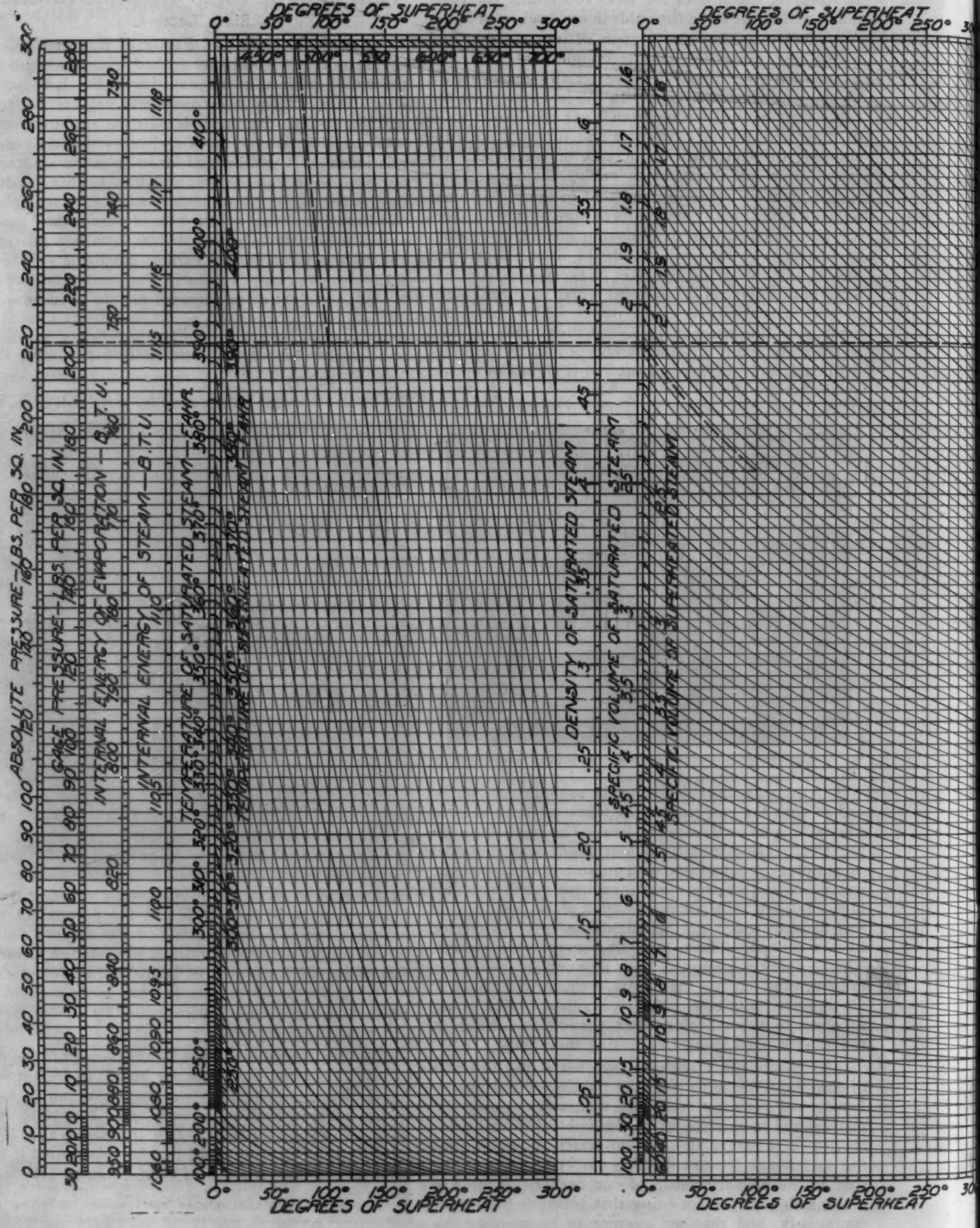
$$11.52\,C + 34.56\,\left(H - \frac{O}{8}\right) + 4.32\,S,$$

where C, H, O, and S are the proportionate parts by analysis of the carbon, hydrogen, oxygen, and sulphur in the fuel.

The mechanical device made use of to supply a proper quantity of air for combustion and to transfer the heat so formed into evaporated water or steam it known as a boiler. It is not the purpose of this lecture to go into the makeup of the modern boiler. If the reader desires to refresh his mind, a description of an efficiency type of boiler will be found elsewhere in the pages of this Journal in an account of a test performed on a Parker boiler by R. F. Chevalier, consulting engineer.

Boilers are usually rated by the number of pounds of water they can evaporate per hour. In 1876 it was found that a one-horse power engine required, as a rule, a boiler of such capacity as could evaporate 34½ lb. of water per hour from 212° F. into steam at 212° F. In our last lecture we found that by experiment it has been proven that it requires 970.4 B.t.u. to evaporate

[1] A resume, devoid of higher mathematics, covering the essentials of a series of lectures now being given by the editor of this Journal before the Senior Mechanical Engineering students at the University of California.


DEGREES OF SUPERHEAT
0° 50° 100° 150° 200° 250° 300°
ABSOLUTE PRESSURE—LBS. PER SQ. IN.
GAGE PRESSURE—LBS PER SQ. IN.
TEMPERATURE OF SATURATED STEAM
INTERNAL ENERGY OF STEAM—B.T.U.
INTERNAL ENERGY OF EVAPORATION—B.T.U.
SPECIFIC VOLUME OF SATURATED STEAM
SPECIFIC VOLUME OF SUPERHEATED STEAM
DENSITY OF SATURATED STEAM
LATENT HEAT OF EVAPORATION-BTU
DEGREES OF SUPERHEAT

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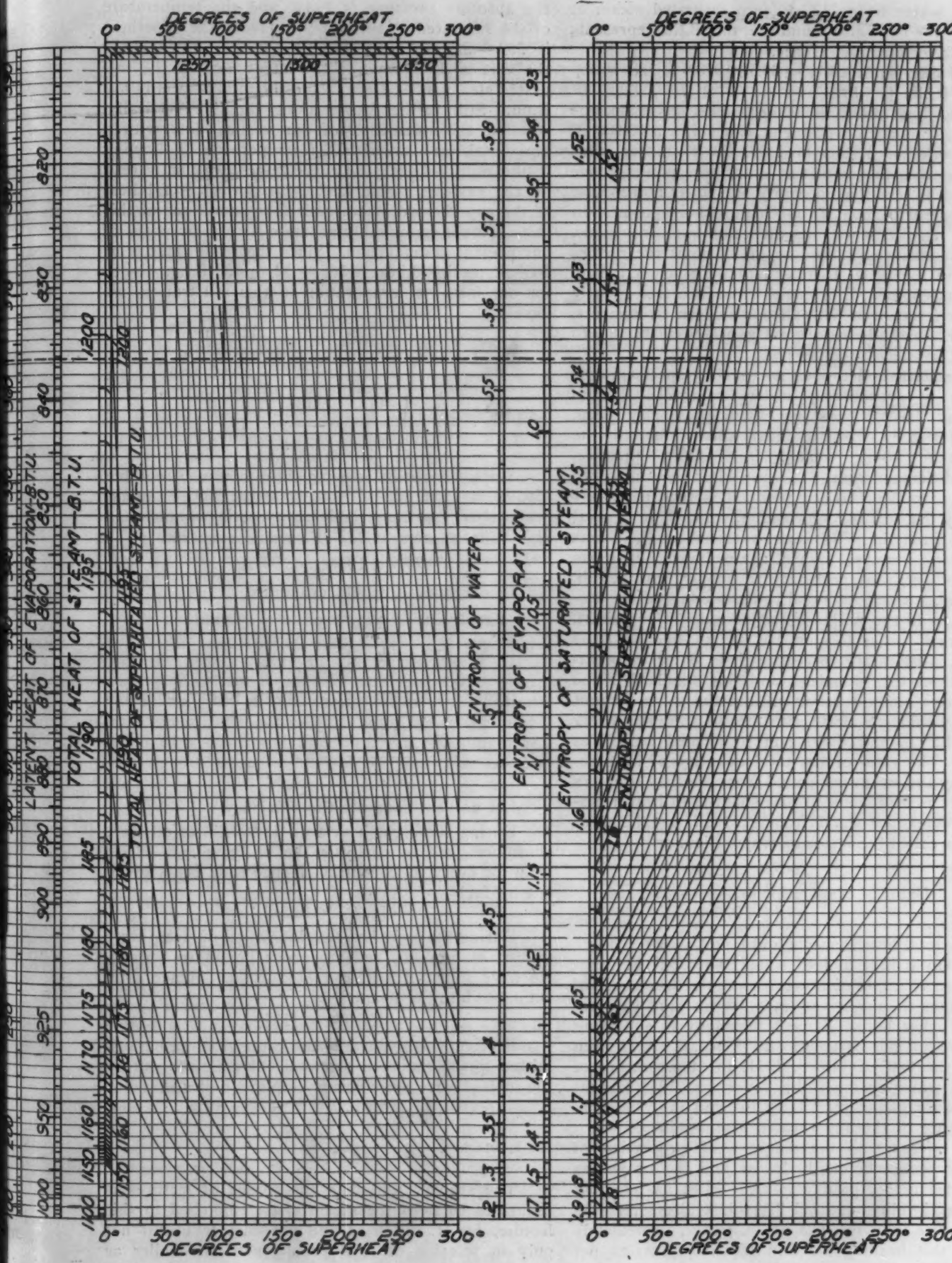

GRAPHIC REPRESENTATION OF THE PROPERTIES OF SATURATED AND SUPERHEATED STEAM.

(To Accompany Lectures on "Primer of Applied Thermodynamics.")

Based upon data from Marks and Davis's Steam Tables.

This chart gives the approximate numerical value and shows the relations existing between the various properties. The dotted line clearly indicates the method to use.

1 lb. of water from 212° F. into saturated steam at 212° F. We have also found that one B.t.u. represents 778 ft. lb. of energy. Hence,

1 boiler horsepower = $34.5 \times 970.4 \times 778 = 26{,}000{,}000$ ft. lb. per hr.

According to our usual mechanical definition, one horsepower is such a power as can perform 33,000 ft. lb. of work per minute or 1,980,000 ft. lb. per hour. By comparing this with the boiler horsepower above defined, it is seen that in reality one boiler horsepower is equivalent to about 13 mechanical horsepower. In a word, in 1876 when this definition was first made, there was the enormous loss of 13 times the energy formed in the boiler to that actually given out from the steam engine. Efficiencies have increased greatly since then, but even with all our modern refinements, we shall later find that a great gap still exists, due to certain thermodynamic laws.

A modern boiler does not simply perform the function of evaporating water from 212° F. to steam at 212° F. As we have previously seen, it is necessary first to heat the water to the evaporation point, which, in modern practice, is far different from 212° F. After heating it to the evaporation or boiling point, it is then necessary to supply the heat of vaporization, which is in general different from the 970.4 B.t.u. required at 212° F. at atmospheric pressure. Then, again, if our boiler has a superheater, it is necessary to supply heat per lb. of steam in an amount equal to the product of the specific heat and the range of temperature of superheat. Therefore in order to compare boilers, one with the other, it is necessary to reduce their water evaporating qualities to a standard, and this standard is the quantitative amount of water that the same amount of heat would evaporate into steam were the water all at 212° F. and the steam so formed remain at 212° F. The ratio of the total quantity of heat absorbed by the steam per pound from the time it enters the boiler as feed water to that quantity of heat necessary to evaporate water from 212° F. to steam at 212° F. is called the factor of evaporation, or

$$\text{factor of evaporation} = \frac{H-h}{970.4}$$

H = total heat in steam and liquid above 32° F.
h = total heat in feed water above 32° F.

As an example of how to compute this factor of evaporation in any given case let us take the test of the Parker boiler above referred to as appearing elsewhere in this issue of the Journal. It is seen that in the test of Jan. 5, 1911, the temperature of the feed water entering the boiler was 165° F, that the pressure gauge read 178.5 lb., and that the final temperature of the superheated steam was 539° F.

By reference to the diagram of properties of steam presented herewith, let us find the properties of steam for this particular case. Let us begin at the upper heading entitled "Absolute Pressure." As our pressure is in lbs. per sq. in. gauge, immediately beneath this heading we find 178.5 lb. pressure per sq. in. Following a vertical line, we find that corresponding to 178.5 lb. pressure per sq. in. gauge, the absolute pressure is 193.2, and the temperature of the saturated steam is 379°. Hence the superheat is $539 - 379 = 160°$. Dropping further down along the vertical line, we find the latent heat of the saturated steam is 847.2 B.t.u., and the total heat is 1197.2 B.t.u. Still further down along the line vertically, we find an intersection of our vertical line with a horizontal line marked 160° for superheat. Following to the right between the curved lines, we finally read on the extreme right, 1288 B.t.u. for the total heat of the superheated steam under the conditions of this test. This is remarkably accurate for the purposes of our present computation. Since the feed water is at 165° F., its liquid heat is 165 — 32, or 133 B.t.u. Hence for our factor of evaporation in this illustration, we have

$$\text{factor of evaporation} = \frac{H-h}{970.4}$$

$$= \frac{1288-133}{970.4} = \frac{1155}{970.4} = 1.19$$

Since this boiler during eight hours evaporated 156.974 lb. from 165° F. into steam at 539° F. superheated 160°, the same boiler evaporating water from 212° F. into steam at 212° F., would evaporate

$$156{,}974 \times 1.19 = 186{,}799 \text{ lb.}$$

In one hour it would evaporate

$$\frac{186{,}799}{8} = 23{,}350$$

Hence its horsepower according to our definition is

$$\frac{23{,}350}{34.5} = 676.7$$

Let us next compute the efficiency.

During the eight hour test, 11,699 lb. of oil were consumed, and by analysis the oil gave out 18,513 B.t.u for every lb. consumed. Hence total B.t.u. given out by fuel

$$= 11{,}699 \times 18{,}513$$

During the eight hrs. test 156,974 lb. of steam were formed at 539° F., and for every pound so formed, we have found it required 1155 B.t.u. Hence total B.t.u. put into the steam

$$= 156{,}974 \times 1155.$$

Efficiency is defined as the ratio of energy transmitted to the steam to the total energy given out by the fuel. Hence the efficiency for this boiler is

$$\frac{156{,}974 \times 1155}{11{,}699 \times 18{,}513} = 83.6\%.$$

The student following this series of lectures is requested to keep the steam chart embodied in this lecture, for it will be found exceedingly useful not only in solution of such problems of the boiler as illustrated above, but for many other applications in succeeding lectures.

Should the student desire to compute the total heat of superheated steam without the use of a chart he should proceed in the following manner. In a previous lecture we have found that the total heat of saturated steam is

$$H = 1150.4 + 0.3745\ (t - 212) - 0.000550\ (t - 212)^2$$

In case the steam is superheated it is necessary for us to add an additional amount of heat to this formula equal to the product of the mean specific heat of superheated steam for the range under consideration and the number of degrees of superheat. Hence our formula becomes

$$H_s = 1150.4 + 0.3745\ (t - 212) - 0.000550\ (t = 212)^2 + k\ (T - t)$$

where H_s = total heat of superheated steam,

t = temperature of saturated steam at boiler pressure,

T = temperature of superheated steam,

k = mean specific heat of superheated steam.

The only quantity that is variable and difficult to arrive at in the above is the proper value of k. Formerly it was thought that k was a constant having a value of 0.48. Recent experiments have shown this to be far from the truth. The following table taken from Peabody's Steam and Entropy Tables represents results compiled from the exhaustive tests of Knoblauch and Jakob, from which the value of k is easily gotten.

Let us find the total heat of superheated steam in the problem above solved by use of the diagrams. Since the abs. pressure in lb. per in. was 193.2, I look under column headed 14 and find 199.1, which is as near a value as I can find without interpolation. Looking vertically downward I find 0.55 at the intersection of a horizontal line from 572° F. superheat, which is the temperature nearest the value of the test.

Hence I proceed as follows:

$$t = 379,\ T = 539,\ k = 0.55$$

$$\therefore H_s = 1150.4 + 0.3745\ (379 - 212) - 0.00055\ (379 - 212)^2 + 0.55\ (539 - 379)$$

$$= 1285.6 \text{ B.t.u. per lb. of superheated steam.}$$

This value is seen to differ by only ¼ of one per cent from the value picked from the chart. By interpretation in the table of superheated steam the value of k is more nearly .56 than .55. Hence it is seen that the two values even more nearly conform.

But one equation now remains and we can be independent of steam tables if we so desire. We need some empiracal rule by which we can compute the temperature of saturated steam when the pressure is given. In Power, March 8, 1910, we find that

$$t = 200\ p^{1/4} - 101$$

in which t is in Fahrenheit degrees and p the pressure in lb. per sq. in. From this let us confirm the above relation that 178.5 gauge or 193.2 absolute pressure exists when saturated steam is at 379° F. Substituting

$$t = 200\ (193.2)^{1/4} - 101 = 200 \times 2.405 - 101 = 380° \text{ F.}$$

The correct temp. is 379° H. Hence there is an error of only about ¼ of one per cent.

A diagram supplying the thus far missing information of liquid heat of steam will appear in the next lecture, thus completing all tables necessary in steam computation.

Thermotwisters.

1. In the test of the Parker boiler found elsewhere in these columns during a ten-hour run 180,240 lb. of water were evaporated from a feed water temperature of 123.4° F. to superheated steam at 561.2° F., the boiler pressure being 179.7 lb. per in. (gauge). What is the factor of evaporation?

2. From the data given in problem 1, compute the horsepower rating of the boiler.

3. During the same test mentioned in problem 1, 14,093 lb. of oil were consumed. The oil has 0.6% water. The calorific value of the dry oil per lb. is 18,681 B.t.u. by analysis, show that the efficiency of the boiler was 83.13%, under the test referred to.

4. A pressure gauge reads 179.7 lb. per sq. in. What is the temperature of the saturated steam in the boiler. Compute by the empiracal formula given above.

Soloution of Thermotwisters—Third Lecture.

1. California oil has a specific gravity of 0.92 and it is found to contain 5% moisture. Apply Le Conte's formula and compute the calorific value per pound of oil.

We must first compute what specific gravity the oil would have were no water present.

Let x = specific gravity of oil free from water.

Then, $.05 + .95x = .92$

$.95x = .87$

or $x = .916$.

Relationship on Beaume scale and specific gravity is

$$B = \frac{140}{\text{sp. gr.}} - 130 \text{ or } B = \frac{140}{.916} - 130 = 22.8$$

Since B.t.u. per lb. of oil = 17680 + 60 B, we have

Calorific value of oil = $17680 + 60 \times 22.8 = 19{,}048$ B.t.u. Ans.

2. A sample of Pocahontas coal is found by chemical analysis to contain the following ingredients:

Carbon	84.87
Hydrogen	4.20
Oxygen	2.84
Nitrogen	0.85
Sulphur	0.59
Ash	5.89
Moisture	0.76
	100.00

Compute by Dulong's formula the calorific value of the coal per pound of fuel.

Substituting in Dulong's formula we have

$$\text{Heating value of fuel per lb.} = 14{,}600\ C + 62{,}000\ (H - \frac{O}{8}) + 4000\ S$$

$$= 14{,}600 \times .8487 + 62{,}000\ (.0120 - \frac{.0284}{8}) + 4000 \times .0059 = 14{,}790$$

Ans.

MEAN SPECIFIC HEAT OF SUPERHEATED STEAM.

p Kg. per Sq Cm. abs.		1	2	4	6	8	10	12	14	16	18	20 abs
p lbs. per Sq. In. abs		14.2	28.4	56.9	85.3	113.8°	142.2	170.6	199.1	227.5	256.0	284.4 abs.
ts Cent.		99°	120°	142°	158°	169°	179°	187°	194°	200°	206°	211° sat.
ts Fahr.		210°	248°	289°	316°	336°	350°	368°	381°	392°	403°	412° sat.
212°	100°	0.463	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
302°	150°	0.462	0.473	0.515	.....	.....	.....	.....	.....	.....	.....	.....
392°	200°	0.462	0.475	0.502	0.530	0.560	0.597	0.635	0.677	.....	.....	.....
482°	250°	0.463	0.474	0.495	0.514	0.532	0.552	0.570	0.588	0.609	0.635	0.664
572°	300°	0.464	0.475	0.492	0.505	0.517	0.530	0.541	0.550	0.561	0.572	0.585
662°	350°	0.468	0.477	0.492	0.503	0.512	0.522	0.529	0.536	0.543	0.550	0.557
752°	400°	0.473	0.481	0.494	0.504	0.512	0.520	0.526	0.531	0.537	0.542	0.547

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Boiler Efficiencies

An efficiency of 83% is remarkable as boiler tests run. Elsewhere in these columns will be found the beginning of an article dealing with a boiler test performed during the year at the Fruitvale station of the Southern Pacific Company's plant in Oakland. The actual test results will be published in the next issue of the Journal. The efficiency as found from the first test proved to be 83.6%, while a test performed some weeks later showed an efficiency of 83.13%. Both are remarkable results and show the wonderful degree of perfection modern boiler design can accomplish.

During the test, data were taken to determine the weight of steam required in atomization of the oil per pound of oil consumed. It is to be hoped many other similar tests may be performed in the near future along the same lines, in order that considerable data may be amassed relative to steam used in atomization. A saving of steam at the burner means just so much energy retained in the boiler. The economic saving of this steam is not usually considered in boiler efficiencies, but it is evident that a saving in the use of steam for atomization means the raising of the efficiency of the boiler so far as dollars and cents are concerned for costs in generating power.

California's Proposed Amendment No. 47.

It takes very little stretch of imagination for us to form a mental picture of the good old days of yore, when our forefathers lived in caves in the mountains, and, by means of brute prowess of the one over the other, kept under control not only the worldly possessions of a neighbor, but even his very physical life and happiness. As a rule, the man of great physical strength must have held sway over the brother of smaller stature. Undoubtedly this state of affairs existed until the smaller brother combined with another small brother, so that by the united effort of the two, the larger brother was made the vassal. And so the conditions of society were gradually built up until groups of individuals formed combinations against other groups, and the stronger held sway over the weaker group.

Finally, for the good of society, it was recognized that property and vested rights of the individual must be protected against all intruders, and, by means of the body politic of the state, society so forced this idea upon the components of a government that it has become impregnated in the very life of all self-ruling peoples. As a fundamental axiom or postulate of the human makeup, however, it must be recognized that what society has at one time decreed society may at some future period after long stages of evolution entirely reverse.

We say we are free, that we have liberties which society cannot take from us. We are free, and we have liberties which society cannot take from us, as long as society so rules. For instance, society may rule to-day that a certain class of undesirable individuals shall be put to death, while to-morrow, society may rule that no individuals shall suffer capital punishment.

The unprecedented industrial development of the

world during the past twenty-five years has forced upon the thinking public new ideas which would have been so startling twenty-five years ago that then they would have been regarded as dangerously revolutionary in character. The general good and well-being of human society, however, has demanded it. The fallacious idea that property interests and property rights are, like the powers of medieval monarchs, of divine right, has been seriously questioned by thinking men, who control the final decrees and dictates of society. The rise of combinations, strong enough in their power to shake and shape the destinies of nations, has added fuel to the thinking mind. The trend of industrial affairs and of our modern mode of living, however, has been the critical factor to ripen the fruits of this thought. The growth of populous cities congested into small areas, necessitating for the very breath of life, a perfect and smooth-running industrial machinery, makes the issue in some cases a life and death struggle. Close down our railways, shut off our electric power generation. demolish or imperfectly operate our water supply for a brief month, and we defy anyone to foretell the outcome. So deeply have the transportation facilities, the water service, the light and heat service, and the thousand daily human necessities of modern life become impregnated in our daily life, the very well-being of human society is at stake.

There is a realization of the great human interests at issue, and throughout our nation is heard a popular demand, and a rightful demand, too, for a supervision of the great human necessities. Like all other great movements, its first days of conception were stormy ones, with the demands of society pitted on the one side crying for unfair and impossible legislation, and the corporate interests on the other side, ugly and unapproachable. We have now arrived at the second period—a period of results and understandings accomplished.

In the older States, where fair-minded and reasonable men have controlled the actions of the Public Service Commission, the public, including the corporation sentiment, is overwhelmingly in favor of the commission form of control for public service corporations. It is an attribute of the thinking human being, distinguishing him from other members of the vertebrate family, the ox, the cow, the mule and the ass, that in his calm, self-possessed moods, he can deal out absolute justice to his fellow men.

The agitation now going on among the voters of the great State of California concerning certain constitutional amendments soon to be decided at the polls, is worthy of more than passing mention. The details of amendment No. 47 can be found elsewhere in the columns of this journal. We believe in proper control by a public service commission. We believe that this control should be specific, direct, and so worded that no misconstruction is possible, but, above all, we believe that when once granted, municipalities as well as private corporations should be brought within the fold of supervision.

The amendment, as proposed, has certain ugly features in its makeup. From the days that Virgil sang his pretty song in the Aeneid, men have known and understood that "variabile et mutabile mulier est"—fickle and changeable is the mind of woman. But read what exquisite fickleness and changeableness it is proposed to allow the municipalities of California:

Senate Constitutional Amendment No. 47, a resolution proposing to the people of the State of California an amendment to section twenty-three of article twelve of the constitution of the State of California, to confer upon the railroad commission power and jurisdiction to regulate and control the business of furnishing certain commodities and performing certain services to or for the public.

[Adopted March 28, 1911]

The legislature, of the State of California, at its regular session, commencing on the second day of January, one thousand nine hundred and eleven, two-thirds of all the members elected to each of the two houses of said legislature voting in favor thereof, hereby proposes to the people of the State of California that section twenty-three of article twelve of the constitution of the State of California be amended so as to read as follows:

Sec. 23. Every private corporation, and every individual or association of individuals, owning, operating, managing, or controlling any commercial railroad, interurban railroad, street railroad, canal, pipe line, plant, or equipment, or any part of such railroad, canal, pipe line, plant or equipment within this State, for the transportation or conveyance of passengers, or express matter, or freight of any kind, including crude oil, or for the transmission of telephone or telegraph messages, or for the production, generation, transmission delivery or furnishing of heat light, water or power or for the furnishing of storage or wharfage facilities, either directly or indirectly, to or for the public, and every common carrier, is hereby declared to be a public utility subject to such control and regulation by the railroad commission as may be provided by the legislature, and every class of private corporations, individuals, or associations of individuals hereafter declared by the legislature to be public utilities shall likewise be subject to such control and regulation.

The railroad commission shall have and exercise such power and jurisdiction to supervise and regulate public utilites. in the State of California, and to fix the rates to be charged for commodities furnished, or services rendered by public utilities as shall be conferred upon it by the legislature, and the right of the legislature to confer powers upon the railroad commission respecting public utilities is hereby declared to be plenary and to be unlimited by any provision of this constitution.

From and after the passage by the legislature of laws conferring powers upon the railroad commission respecting public utilities, all powers respecting such public utilities vested in boards of supervisors, or municipal councils, or other governing bodies of the several counties, cities and counties, cities and towns, in this State, or in any commission created by law and existing at the time of the passage of such laws, shall cease so far as such powers shall conflict with the powers so conferred upon the railroad commission; provided, however, that this section shall not affect such powers of control over any public utility vested in any city and county, or incorporated city or town as, at an election to be held pursuant to laws to be passed hereafter by the legislature, a majority of the qualified electors voting thereon of such city and county, or incorporated city or town, shall vote to retain, and until such election such powers shall continue unimpaired; but if the vote so taken shall not favor the continuation of such powers they shall thereafter vest in the railroad commission as provided by law; and provided, further that where any such city and county or incorporated city or town shall have elected to continue any powers respecting public utilities. It may, by vote of a majority of its qualified electors voting thereon, thereafter surrender such powers to the railroad commission in the manner to be prescribed by the legislature; or if such municipal corporation shall have surrendered any powers to the railroad commission, it may, by like vote, thereafter reinvest itself with such power.

Nothing in this section shall be construed as a limitation upon any power conferred upon the railroad commission by any provision of this constitution now existing or adopted concurrently herewith.

The good of California demands commission regulation. Let us make this regulation uniform and secure. An amendment that allows a municipality to be regulated of its own free will by a commission to-day and, should the shoes pinch on to-morrow, to withdraw within itself, is not only unfair to our public service corporations, but a danger to stability in the government of our commonwealth.

PERSONALS.

Hal. Lauritzen, western field manager for the Holophane Company, is at San Francisco.

P. C. Butte, manager of the Butte Engineering and Construction Company of San Francisco, is at Vancouver, B. C.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, is at Los Angeles.

W. L. Goodwin, vice-president of the Pacific States Electric Company, is at Los Angeles on a business trip.

Charles L. Turner has been made assistant manager of the Los Angeles house of the American Ever Ready Company.

H. F. Froesch of the Federal Electric Sign Company, died at San Francisco on September 27th. Interment will be at Chicago.

Lee C. Moore of Pittsburg, Pa., builder of transmission line towers, is visiting the Pacific Coast, now being in Los Angeles.

H. Bostwick, secretary to John A. Britton of the Pacific Gas & Electric Company, is on his way to Honolulu for a two weeks' vacation.

J. W. Swaren is conducting a department of the Town and Country Journal of San Francisco devoted to the application of power to farming.

J. H. Clover has resigned his connection with the Holophane Company to become sales engineer with the Pacific States Electric Company.

J. A. Vandergrift, manager of the Oakland warehouse of the National Electric Lamp Association, has returned from a trip through the Northwest.

J. P. Edwards, the electrical and mechanical engineer of the Northern Electrical Railway Company, of Chico, was at San Francisco during the past week.

Frank H. Morgan, an electrical engineer of Liverpool, England, has been spending a few days at San Francisco, while looking over the principal electric transmission systems of this country.

A. L. Collins, formerly assistant engineer with the Sacramento Valley Irrigation Company at Willows, Cal., is now with Duryea, Haehl & Gilman, consulting engineers, at San Francisco.

John S. Baker, Pacific Coast district manager of Crocker-Wheeler Company, has returned to San Francisco, after visiting Los Angeles on business connected with a hydro-electric project.

John L. McCandless, president of the Hawaiian Electric Company, Ltd., of Honolulu, passed through San Francisco during the past week, on his way from the Islands to the Northwest.

S. E. Doane, chief engineer of the National Electric Lamp Association, is making a Pacific Coast trip. Te spent the past week in the Northwest and after visiting Southern California will return East.

J. P. Bradner was married at San Francisco on September 27 to Mrs. M. L. Luce. Mr. Bradner's many friends among the engineers and power companies of the Coast are offering him their most sincere congratulations.

Malcolm McIntyre, general superintendent of the San Francisco, Vallejo & Napa Valley Railway Company, and George A. Hearn, the company's chief electrician, were recent arrivals at San Francisco from Napa.

John Finnegan, the purchasing agent of the United Railroads of San Francisco, will attend the National Street Railway Convention at Atlantic City next week. S. K. Colby, of Pierson, Roeding & Co., will also be in attendance.

J. B. Ingersoll recently resigned as chief engineer of the Spokane & Inland Empire Railroad Company at Spokane, Wash., to accept a similar position with the British Columbia Electric Railway Company at Vancouver, B. C.

Chas. E. Hearn, city sales manager of the Electric Appliance Company, is retiring from that office to represent the company in Arizona, New Mexico and Southern California. Mr. A. Meinema will succeed Mr. Hearn as city sales manager.

John Coffee Hays, general manager of the Mt. Whitney Power Company, is again at San Francisco after visiting Visalia in connection with the closing of contracts for additional hydroelectric equipment at one of the company's power stations.

Garnett Young, general manager of the Telephone Equipment Company of California has been entertaining a number of the company's sales managers at his offices in the Security Building during the past week on the occasion of their annual meeting.

W. S. Heger, formerly representing the Allis-Chalmers Company, at San Francisco, returned to his home in Marin county a few days ago after an enjoyable Eastern trip during which he renewed old acquaintanceships at Milwaukee and in Delaware.

Earle G. Alexander, who has been connected with the sales department of the California Electrical Construction Company, will shortly take charge of the new electrical supply house, which is to be established at 633 Howard street by the Larbeer Electrical Supply Company of Los Angeles.

F. J. Cram, sales manager of the Electric Appliance Company of San Francisco, will leave for Chicago next week and will spend a month in visiting the various factories represented. He will attend the coming Jovian Congress at Denver, October 16, 17 and 18, while on his way East.

Frank G. Drum, president of the Pacific Gas and Electric Company, has returned to San Francisco after spending some days at New York. He does not officially confirm the rumors that negotiations are in progress for the absorbing of the Great Western Power Company and the Sierra and San Francisco Power Company.

C. W. Burkett, electrical engineer for the Pacific States Telephone Company, very entertainingly supplemented Max Thelen's address on Public Service Commissions at the recent San Francisco Branch meeting of the A. I. E. E., by giving some personal experiences of his pleasant past relationship with the Public Service Commission of Wisconsin.

R. E. Starkweather, with F. G. Baum & Co., has returned to San Francisco, after looking over the electric power transmission field around San Bernardino. The D. A. Chappell interests are preparing to extend their lines from Bishop Creek into that territory, and the Edison Electric of Los Angeles is contemplating a San Bernardino extension from the south.

C. E. Johnson, who has been sales manager of the American Ever Ready Company's San Francisco factory for some time, is now in the Northwestern territory, his place being filled temporarily by F. E. Blanchfield. The latter has been ill during the past year, but expects soon to be able to return to the management of the Northwest branch of the company at Seattle.

F. L. G. Knox, consulting electrical engineer for W. P. Hamon Company, read a very interesting letter at the recent San Francisco Branch meeting from Gano Dunn, president of the American Institute of Electrical Engineers. The letter was written while Mr. Dunn was en route to the international electrical congress at Turin and assured the San Francisco men of his hearty and earnest co-operation in all endeavors to get an international electrical congress at San Francisco in 1915.

G. C. Noble, consulting engineer and assistant professor of electrical engineering at the University of California, has passed in his resignation to the Regents of the State institution to accept a very flattering offer with the Pacific Gas and Electric Company. Mr. Noble is receiving the sincere congratulations of his many friends.

ELECTRICAL CONTRACTORS' NOTES.

First Vice-President Heilbron of San Diego, reports business fair in his section of the country.

Harry Tittel, manager of the electrical department of the John G. Sutton Co., is spending a few days at Vancouver, where he has a number of jobs.

W. McNally, secretary Pasadena contractors. spent a few Pasadena by the W. A. McNally Company for the sum nicely among the contractors in Pasadena.

A large street lighting contract was recently landed in Pasadena by the W. A. McNally Company for the sum of $15,000. The above figure includes lamp posts and underground wiring (municipal system).

Bill Hanbridge, Jr., small son of the secretary of the State Electrical Contractors' Association, passed away, Saturday, September 30th, after a two weeks' illness caused by getting a nail in his foot while at play in the country. The funeral and interment took place at San Jose during the past week.

TRADE NOTES.

The Wirt Electric Specialty Company of Philadelphia has just issued an attractive pamphlet on "The Dim-a-Lite." The booklet is amusing in its portrayal of human nature.

The Butte Engineering and Supply Company was recently awarded a contract for a special electric crane for use at the Mare Island Navy Yard. It will be a 3-phase high-speed traveling crane intended to carry timber into the sawmill connected with the yard.

"Modern Electric Lamp Manufacture and Lighting Economies" was the subject of a joint lecture at Santa Cruz, California, on September 28, by Frank W. Loomis of the Holophane Company, and F. D. Fagan of the General Electric Company. This was given under the auspices of the Chamber of Commerce at the Unique Theatre.

The Pelton Water Wheel Company has taken a contract to build for the Mount Whitney Power Company a Pelton-Francis turbine which is to be direct connected to a General Electric generator and installed in the No. 2 power station near Visalia, replacing three generating units driven by three wheels. The new wheel is rated at 2250 h.p. and will operate under an effective head of 360 feet at 720 r.p.m.

The Chicago, Milwaukee and St. Paul, which is already operating approximately 2000 miles of track by the telephone has recently ordered of the Western Electric Company 75 telephone selectors for use on its Hastings and Dakota Division. Three circuits will be installed, the total mileage being about 390 miles. One circuit will run from Montevideo, Minnesota, to Minneapolis, Minnesota, with a branch from Benton Junction to Farmington Yards. There will be twenty-eight stations on this circuit and the dispatcher will be located at Montevideo. A second circuit will run from Aberdeen, South Dakota, where the dispatcher will be located, to Mobridge, South Dakota, a distance of 98 miles, and will be equipped with twelve stations.

The United States Reclamation Service has recently ordered from the Westinghouse Electric & Mfg. Co., for installation on the Boise Project, Idaho, three 625 k.v.a., 22,000 volt, 3-phase air blast type transformers. The government has installed on this project a hydroelectric power plant for furnishing energy to motor driven pumps used for irrigating purposes. As the irrigation season occupies only the summer months, the plant will be kept in part operation during the winter for the purpose of supplying light to the farmer and the small towns on the project. This company has also recently received a contract from the United States Quartermaster's Department, for furnishing the necessary transformers, wattmeters and switchboards for the Army Post located at Fort Bliss, Texas, and at the Angel Island Recruit Station near San Francisco. The Post is to have an electric lighting system installed, energy being purchased from the local electric power company. The apparatus is for the purpose of distributing, controlling and measuring the current consumed in the various buildings of these army posts.

MEETING NOTICE.

The National Electric Light Association meets in Seattle next June and an electrical exposition will be held in Seattle at that time. Arrangements have been made whereby the Armory will be used for this purpose. Space will be given free of charge to any one of the electrical manufacturers who wish to exhibit. No charge for admission will be made.

The members of the Seattle Section of the American Institute of Electrical Engineers met at dinner at the Arctic Club on the evening of September 16. This being the first meeting after the summer recess, no formal paper was presented. Secretary Whitney reported the business transacted at the Chicago national meeting and Chairman A. A. Miller outlined a comprehensive plan of action for the next year. In all likelihood a Pacific Coast meeting will be held at Seattle about the time of the National Electric Light Association's convention there.

BOOK REVIEWS.

Addresses to Engineering Students. By Waddell & Harrington, consulting engineers. Size 6x9½ inches; 493 pages; clear type, durable binding. Published by Waddell & Harrington of Kansas City, Missouri, and for sale by Technical Book Shop, Rialto Bldg., San Francisco. Price $1.00.

Messrs. Waddell & Harrington, consulting engineers, have added many noted engineering structures to the engineering art, but never a more lasting monument could be erected than this interesting and helpful compilation of addresses to engineering students. Within its covers will be found addresses by such men as Dean J. B. Johnson, Charles W. Eliot, Walter C. Kerr, Dugald C. Jackson, Dr. M. E. Cooley, the authors themselves, and a host of others The whole tone of the book is so wholesome, so optimistic, so full of the very juice of life, an engineer, be he young or old, can ill afford not reading it.

Power Plant Testing. By Professor J. A. Moyer. A manual of experimental engineering; size 6x9¼ inches; 436 pages; 271 illustrative figures; cloth binding. Published by McGraw-Hill Book Company of New York, and for sale by Technical Book Shop, Rialto Bldg., San Francisco. Price. 4.00.

The author's long experience in engineering testing both in the technical colleges and in the great industrial companies has made him peculiarly adapted for the production of a manual of testing suitable for the needs of the students and yet applicable also for the engineer in the practice of his profession. The book discusses all the latest methods for testing engines, turbines, boilers, pumps, refrigerating machinery, fans, fuels, and materials of construction. The book is an excellent college text-book and being so recent is indispensable to the testing engineer.

INDUSTRIAL

AGUTTER-GRISWOLD COMPANY'S NEW FACTORY.

Electrical appliances of all sorts are manufactured by the Agutter-Griswold Company, which recently completed a new factory at the corner of Aloha and Howard streets, Seattle. The rapid growth of this concern demonstrates the industrial possibilities of the Pacific Northwest as well as any instance that might be picked out. Starting in humble quarters about four years ago, it has expanded rapidly until today it is the leading manufactory of its kind in the West.

The Agutter-Griswold Company's new building consists of

1. Factory at Aloha and Howard. 2. Section of General Offices. 3. View of Assembly Floor. 4. Plating Department. 5. View of Machine Shop. 6. Steel Box Department.

three stories and a basement. It is a concrete structure, 60x120 feet, with 21,000 square feet of floor space. The first floor is used for office and storeroom purposes. The heavy machinery required for punching and forming switch and panel parts is housed on the second floor, where some of the assembling work is also done.

Other machinery required in the construction of steel cabinets is located on the third floor. It also accommodates the plating, lacquering and polishing department. The building is equipped with fireproof vaults for the storage of documents, dies and expensive tools used in the various manufacturing processes. All the machinery is electrically driven.

ILLUSTRATIVE REPORT FROM WALL STREET JOURNAL

In comparison with most industrials the business of the Western Electric Company is holding up remarkably well. Although four out of the last five months have shown a decrease in gross business, the falling off has been so slight that the increase in the first three months is sufficient to make the whole eight months that have elapsed, show a gain of 3 per cent over the corresponding eight months of 1910.

August was off about 3 per cent as compared with August, 1910, July was also off 3 per cent from last year, June off 4 per cent, May showed a slight gain and April a falling off of about 4 per cent in comparison with April. Business so far has run at the rate of about $66,000,000 for the year, and as there are only four months left it seems more than likely that 1911 will rank as the company's second largest year, even taking into consideration further decreases, which may or may not materialize. On the basis of gross sales of $66,000,000 this year would compare with previous years as follows:

	Gross Sales.	Increase.	P. C.
1911	*$66,000,000	$ 5,000,000	8
1910	61,000,000	15,000,000	32
1909	46,000,000	13,000,000	40
1908	32,000,000	†21,000,000	†39
1907	53,000,000	†16,000,000	†23
1906	69,000,000	25,000,000	56
1905	44,000,000	12,000,000	37
1904	32,000,000	2,000,000	6
1903	30,000,000	1,000,000	3
1902	29,000,000	5,000,000	20
1901	24,000,000		
1900	24,000,000		
Total	$510,000,000		

*Estimated.
†Decrease.

The falling off in business has come chiefly from the eastern section of the country, the south, the middle and far western territories showing improvement as compared with last year.

NEWS NOTES

FINANCIAL.

ALBANY, ORE.—The Mayor will appoint a committee to investigate the feasibility of a $500,000 water system.

LEAVENWORTH, WASH.—A $50,000 bond issue is to be submitted to the voters of Leavenworth at an early date. The funds are to pay for the municipal water plant.

GRESHAM, ORE.—The Gresham water system bonds issue of $20,000 has been decided in favor of the issue and work on the water system is to begin as soon as possible.

SACRAMENTO, CAL.—Ten of the first consolidated mortgage 5 per cent bonds of the Sacramento Electric, Gas & Railway Company will be retired in accordance with the provisions of the sinking fund. Bids for the sale of this or a similar number of bonds will be received by the Mercantile Trust Company of San Francisco, as trustee, prior to noon of October 30, 1911.

ILLUMINATION.

ABERDEEN, WASH.—The City Council is considering the advisability of installing a municipal lighting plant.

TRACY, CAL.—An application for a franchise to establish a gas plant in this city, has been presented by H. F. Tillotson, of San Francisco.

SNOHOMISH, WASH.—The local council is conferring with the Everett Gas Company in regard to the betterment of the local lighting system.

THE DALLES, ORE.—The Hydroelectric Company of Hood River is asking a fifty-year franchise of this place for supplying the city with light.

SEATTLE, WASH.—The City of Seattle will erect an $8631 power plant at 1179 Eastlake avenue. B. H. Graff, 601 American Bank Building, contractor.

ASHLAND, ORE.—It is probable that officials of the Siskiyou Power & Light Company will submit a proposal to this municipa'ity for the purchase of the municipal power plant.

THE DALLES, ORE.—N. C. Evans of Hood River asked for the right and franchise to erect and maintain poles and wires, and supply The Dalles with electricity for power and lights.

WHITTIER, CAL.—C. S. S. Forney, president of the Southern Counties Gas Company, has appeared before the City Council and asked that a gas franchise be advertised for sale.

WOOLLEY, WASH.—A franchise for the Bellingham and Skagit County Interurban Railway Company, to operate an electric lighting and power station in this city has been applied for.

MEDFORD, ORE.—The Southern Oregon Electric Company has received the contract for a street cluster lighting system at a bid of $37 per post and 28 cents per running foot for wiring.

TACOMA, WASH.—Griffin Wheel Company has awarded a contract to Evans-Dickson Company, electrical engineers, for the installation of a complete lighting system in their plant. The work will cost $1500.

LOS ANGELES, CAL.—The Board of Supervisors has awarded the contract for placing an electric generating plant in the Hall of Records to the C. C. Moore Engine Company at their bid of $21,000.

VANCOUVER, WASH.—It is reported that the Skamania Light & Power Company, S. Sampson of Stevenson, Wash., president, will apply for a franchise to enter the city with a power and electric light line.

WALLACE, IDAHO.—The Washington Power Company will at once extend its lines into Sunset County for the purpose of furnishing power for the Manhattan and Amazon mines. The company's engineers are on the ground instituting work.

FULLERTON, CAL.—The city has entered into a three years contract with the Southern California Edison Company for an improved lighting system. The plans being to use about seventy-five large tungstens and the adoption of a center suspension.

SEATTLE, WASH.—The county commissioners will on October 24th consider the application of Roy W. Comegys for a franchise for rights of way over certain county roads and streets for the construction of electric light lines and electric light systems.

ANACORTES, WASH.—Julius Nelson, J. P. Benton and E. D. Nelson have petitioned the municipal council for a 30-year franchise for a gas service. They propose the immediate erection of a gas plant and mains and laterals for high-grade lighting and heating purposes.

SAN FRANCISCO, CAL.—Word has been received from the authorities in Washington awarding the contract for the construction of the electrical system at Fort Miley to the McFell Electrical Company, on their bid of $17,210. The work includes the complete installation of an electric light system.

PASADENA, CAL.—The City Council has awarded a contract for the work on Orange Grove avenue, between Colorado street and Columbia street, and on Colorado, California and Columbia streets to W. A. McNally & Co., at $30,400, for installing lighting posts, underground cables and wires.

INCORPORATIONS.

IRONDALE, CAL.—The Irondale Electric & Power Company has been incorporated for $50,000, by F. M. Brown, J. D. Phillips and others.

PHOENIX, ARIZ.—The Thousand Springs Power Company has been incorporated for $2,000,000, by F. N. Bancroft, vice-president, and J. J. Crippen, secretary. The home office is in Denver, Colo.

LEBANON, ORE.—The Sweet Home Water Company has been incorporated by R. C. Watkins, W. M. Malone, A. Schippl and J. H. Goings. The company expects to begin work at once on the building of a reservoir on the hill near the school house a half mile east of the town.

MARTINEZ, CAL.—Acting for some new water company which is planning to enter Contra Costa and Alameda counties in opposition to the People's Water Company and the Union Water Company, Charles Bacon of a local abstract firm Saturday filed two water appropriations for 60,000 inches of water to be taken from the San Joaquin River. Bacon refused absolutely to be questioned in any way, and would not even state who he was acting for. He did admit to one of the clerks in the county clerk's office, however, that the new water company was planning to supply Oakland, Brentwood, Walnut Creek, Concord, Byron and Livermore.

TRANSMISSION.

GRIDLEY, CAL.—The Gridley Produce & Canning Company's creamery and ice plant is preparing to install its own power and lighting plant.

WALLACE, IDAHO.—The Washington Water Power Company will at once extend its line to the Sunset country, primarily to furnish power for the Manhattan and Amazon mines.

REDDING, CAL.—Peace has settled down again upon the lines of the two power companies that have been at war in Shasta County. A stipulation provides that the Sacra-

mento Valley Company, which is building its system, shall correct three of the crossings where it passes over the lines of the Northern California Company. The Sacramento Valley Company agrees to construct all crossings in the manner that shall be decided best by the two engineers.

BLAINE, WASH.—The construction of the transmission line of the British Columbia Electric Company from Cloverdale, B. C., to this place only awaits the ratification of the contract by the city council.

VENICE, CAL.—The Abbot Kinney Company will build a power house here to compete with the Southern California Edison Company. Orders for machinery have been placed and an investment of $100,000 is planned.

SAN BERNARDINO, CAL.—City Engineer Poole and other officials of the Southern Sierra Power Company will be here soon and finally pass on the surveys of the high power line and also the plans for the power house to be erected between San Bernardino and Colton.

MARTINEZ, CAL.—Maps and permits showing the route to be taken along the waterfront by the Great Western Power Company in its invasion of the territory formerly held exclusively by the Pacific Gas & Electric Company, were filed with the county clerk yesterday. The entrance of this company into the field here is creating a great deal of interest among the officials of the large manufacturing plants, as it is stated they are offering power and heat at about one-half that charged by the latter company. Franchises along the waterfront from Crockett to Martinez grant the company right over many miles and the privilege of opening a plant at Martinez.

TRANSPORTATION.

KAMLOOPS, B. C.—This place is considering the advisability of spending $223,000 for securing hydroelectric power from the Barrier river.

BURLINGTON, WASH.—The City Council has granted a franchise to the Bellingham-Skagit interurban to pass through the city from north to south.

HUSUM, WASH.—The Pacific Power & Light Company has applied for a permit to construct an electric line from the plant at this point to Underwood.

EUGENE, ORE.—The Oregon Electric Railway Company has surveyors at work near here establishing levels preparatory to active construction work in the near future.

SEATTLE, WASH.—City Engineer R. H. Thomson has been instructed to prepare plans for the construction of the Seattle-Renton electric railway system of this city. Estimated cost, $800,000.

VICTORIA, B. C.—It is announced that the British Columbia Electric Railroad Company will proceed at once with the construction of 18 miles of suburban extension of that road along the Saanich peninsula.

WHITEFISH, MONT.—It is announced that D. R. McGinnis, Flathead capitalist, is making arrangements to finance the proposed Kalispell-Whitefish electric road, and it is thought that work will start this fall.

VANCOUVER, WASH.—It is reported that the Mount Hood Railway & Power Company will expend more than $1,000,000 in building electric lines in Vancouver and Clark county within the next two years.

MOSCOW, IDAHO.—It is announced that the Spokane & Inland Empire railroad will erect stations on the Moscow and Colfax lines. Plans are now being prepared at the office of R. Budd, chief engineer, in Spokane.

SANTA ANA, CAL.—The City Council has passed an ordinance relating to the franchise of the Santa Ana and Westminster Railway Company on Second street, so that electricity may be used as motive power on Second street.

SANTA MONICA, CAL.—The City Council has passed an ordinance granting to the Los Angeles Pacific Company the right to construct and for a period of fifty years operate a single or double track electric railroad upon certain public streets of this city.

CHELAN, WASH.—H. M. Herzog of Seatte, at the head of a company of engineers, has started surveying the Chelan river gorge. It is reported that this work is being done for the location of the dam contemplated by the Great Northern for the development of power.

SEATTLE WASH.—The City Council has passed a resolution, instructing the board of public works to call for bids for the construction of a municipal car line where the old Renton line is now located. The next step will have to be taken by the Board of Public Works.

BAKER, ORE.—F. A. Harmon and E. P. Bodinson, local delegates of the Commercial Club on the feasibility of constructing an interurban railway from this city to some outside point, have returned from Boise, Idaho. The delegates were enthusiastic in regard to the proposed line.

VANCOUVER, B. C.—A plan is on foot for the construction of an electric line and supplying electric power to private consumers throughout the Okanagan valley. This is to be done under a charter granted to the Coteau Power Company and recently acquired by Wm. Mackenzie, Donald Mann and their associates.

BAKERSFIELD, CAL.—Application has been made to the Board of Trustees by the San Joaquin Light & Power Company for a franchise, for a period of 50 years, to construct and maintain a street railroad upon certain public streets and highways, to be operated by electricity in the city of Bakersfield.

MISSOULA, MONT.—Charles A. Clark, representing his father, W. A. Clark, announces that he has ordered the local officials of the Clark Street Railway Company to start surveying immediately for an electric railway from Missoula across the southwestern portion of the Flathead country to the foot of the Flathead lake.

VANCOUVER, WASH.—The City Council has practically agreed to grant an electric railway franchise to Lawrence Harmon, said to represent Chicago capitalists. The company represented binds itself to have at least three miles of road in operation by April, 1914, and is also expected to build into various parts of Clark county.

SEATTLE, WASH.—It is announced that Dibble-Hawthorne & Co., Bank of Commerce Building, Tacoma, have secured the contract for constructing the electric line from Oxbow to Lake Burien for the Highland Park & Lake Burien Railway Company, American Bank Building, Seattle, at approximately $150,000, to be seven miles in extent.

LOS ANGELES, CAL.—Plans for a five-mile track to be the connecting link of the Corona and Colton systems, and giving a clear run from Corona to Riverside and San Bernardino were made by the Pacific Electric officials recently. Work on the track will be started at once, P. D. Wing being commissioned by the company to procure the proper franchise.

MARTINEZ, CAL.—The positive assurance has been given that if the people of Martinez, Alhambra Valley and the surrounding country will subscribe to stock and buy bonds in the sum of $150,000, an electric line will be built from the county seat through the Alhambra Valley to Walnut Creek, connecting there with the main line of the Oakland & Antioch Railway.

SAN FRANCISCO, CAL.—The United Properties Company has given out a contract for $2,000,000 worth of electrical equipment. Just what this order consists of cannot be learned, but it is believed that this is the first move toward important extensions of the Key Route system. According to President E. A. Heron, work on the system north to Richmond and San Pablo and south to San Jose will be rushed within the next few months.

PORTLAND, ORE.—Chicago capitalists have organized a company to construct an electric line from Vancouver, Wash., north to the South Fork of the Lewis River, north-

east to Klickitat Pass, a distance of 100 miles. In addition to the electric line, the promoters will operate coal mines, sawmills and townsite properties. Between $10,000,000 and $15,000,000 is back of the project. H. L. Harmon of Chicago is promoting the enterprise. In his absence E. R. Ernsberger, of the Mt. Hood Railway & Power Company, looks after the interests of the concern.

SAN FRANCISCO, CAL.—It is announced that the laying of steel for the Tidewater & Southern railroad will begin at Turlock within a week. J. H. Wallace, chief engineer of the company, has completed arrangements with the Southern Pacific Company for the construction of a spur track within the city limits of Turlock to connect the Southern Pacific's main line with the right of way of the Tidewater Southern, thereby permitting the transfer of cars loaded with ties, steel and equipment from one system to the other. Grading of the right of way from a considerable distance north has been completed to the limits of Turlock, but the Tidewater and Southern management decided to refrain from tearing up city streets until absolutely necessary.

SAN FRANCISCO, CAL.—A loop for the western end of the Geary street city railroad has been recommended to the Mayor and Supervisors by Patrick Broderick, the superintendent of construction of this railway, and Public Works Commissioner Charles S. Laumeister. The loop plan provides for the following route: From Thirty-third avenue along Pt. Lobos avenue to Forty-eighth avenue, thence along Cliff avenue and the Great Highway to C street, along C street to Thirty-seventh avenue, and then on Thirty-seventh avenue, B street, Thirty-sixth avenue, A street and Thirty-third avenue to Point Lobos avenue. It is stated by Broderick and Laumeister that this scheme will keep the city railway from crossing the United Railroads tracks and the use of the United Railroads tracks will be wholly avoided.

TELEPHONE AND TELEGRAPH.

FRESNO, CAL.—A complete telephone system is to be established along the route of the Guaranty Pipe Line Company from the Midway oil field to Ventura and bids are now being received pending the letting or the contract.

FORT SHAW, MONT.—J. B. Bond, engineer of the Sun River Irrigation project, is in the canyon and Willow Creek, located near this city, arranging for the immediate construction of a telephone line between Willow Creek and Warm Springs.

HANSEN, IDAHO.—A movement is well along by independent and disconnected rural telephone systems in Twin Falls county for the connection of all the rural lines. The territory served will be widened by the additional construction of lines.

SEATTLE, WASH.—The U. S. transport Burnside has departed for Alaska waters to start repair work on the government cable between Sitka and Valdez.

VALE, ORE.—The city has decided to permit the Independent telephone line to come into the city.

BAKERSFIELD, CAL.—Bids are about to be sought from Bakersfield building contractors for construction of the three-story and basement building of the Pacific Telephone & Telegraph Company on the north side of Twentieth street. The building, equipped as a central office and exchange, will cost $80,000. Although the general plans were made in the architectural office of the company at San Francisco, Orville L. Clark of this city will be supervising architect. The building will be made of reinforced concrete with facade of mission design, executed in cement with brick and granite trimmings.

COLUSA, CAL.—The committee of telephone patrons appointed to meet with the directors of the Colusa County Telephone Company Saturday afternoon received little encouragement, the officials remaining firm in their decision to raise the telephone rates, beginning October 1. They made no impression on the officials of the telephone company, which has no competition in this county. They were informed to present the notice, which is signed by 110 subscribers to the main ofice and the instruments of the protesting parties would be removed. The committee was also informed that to again obtain a telephone after the instrument is once removed would cost $5 besides the regular rate. The directors of the telephone company are J. F. Campbell, Oscar Robinson, J. H. Balsdon, Charles Schaad and Dr. W. T. Bathbun.

LOS ANGELES, CAL.—Reports are current here that the Home Telephone Company is planning to sell its plants and equipment in California to the Pacific Telephone & Telegraph Company. It is stated that the deal will include the Home Company of Los Angeles, the Bay Cities, which embraces those at San Francisco, Oakland and Berkeley, and the subsidiary concerns in the State. It is no secret that the Home Company has found it an uphill fight against the Pacific, especially in San Francisco and the other cities about the bay. For a time its business here gave promise of great proportions, but of late the Pacific has strengthened itself through the purchase of a number of small companies in Southern California. It is thought that the deal may take the form of a consolidation or merger, through which the holders of Home Telephone securities would be given bonds or stock of the Pacific Company. Officials of the two companies state that the matter has not reached a stage where it can be discussed.

WATERWORKS.

HERMISTON, ORE.—Hermiston will advertise for bids for the sale of bonds for the construction of the Hermiston water system.

VISALIA, CAL.—Exeter has voted for a new water system, carrying the $42,500 bonds by a vote of 120 to 8. The success of the bond issue means the extension of the water system and fire protection all over the municipality.

JACKSONVILLE, CAL.—A contract for the completion of the Jacksonville waterworks system, began last year by J. I. Mears, has been awarded to the Jacobson-Bade Company for the sum of $43,000 less the amount of estimate allowed Mears for the completed work and material.

HONOLULU, T. H.—Bringing water from the windward side of the island at a cost of $1,500,000 is the plan of the two engineers, J. B. Lippincott and Carl Worthen, who have been studying the proposition for the Oahu Sugar Company. Roughly, the plan is to bring the water by a tunnel at the head of Walahole gulch through to the head of Waihawa gulch and from there distribute the water where needed. The system will have a capacity of 100,000,000 gallons daily, and a daily minimum flow of 15,000,000.

BAKERSFIELD, CAL.—The Western Water Company, a Bakersfield corporation, plans to supply Taft and the Midway field with a fresh water supply taken from wells sunk near the river, and has completed its station No. 1 at the water wells and is awaiting the pumping machinery. Four miles of the pipe line ditch, have been completed and a ditching machine is now to be used to complete this work, and it is expected to make progress at the rate of close to a mile a day. The company expects to be delivering water to its customers by October 1, when a supply of 20,000 barrels will be available. Contracts are now being made with the oil companies of the Midway territory, the Union Oil Company having contracted for 10,000 barrels a day for five years. Station No. 2, in the town of Taft, is now being made ready. The plant is in triangular tract at the head of Kern street, extending from North to Lucard street, with 250 feet frontage on Lucard and 640 between North and Lucard. The main office will be opposite Kern street. It will be a frame building. The power house will be on Lucard street, with the supply warehouse in the rear.

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